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AN ANALYSIS OF USAF DEPOT LEVEL MAINTENANCE
CAPABILITY TO MEET SURGE REQUIREMENTS FOR A
RIW ITEM: THE C/KC-135, C-141 INERTIAL
NAVIGATION SYSTEM

AIR FORCE INSTITUTE OF TECHNOLOGY
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

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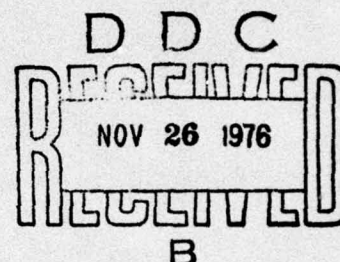
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Gary W. Sharp, Captain, USAF
John C. Toshach, GS-12

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This study presents an analysis of the impact of an RIW contract on the maintenance support of the C/KC-135, C-141 inertial navigation system in the event of a national emergency. The study revealed that adequate support could be maintained through a combination of the INS contractor's maintenance support and the repair capability that could be developed by in-house repair facilities, if the contractor meets the guaranteed MTBF. Failure to meet the guaranteed MTBF would result in disruptions of support. The study recommends an analysis of support capabilities to meet national emergency surges prior to commitment to Reliability Improvement Warranties for sole maintenance support.

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AN ANALYSIS OF USAF DEPOT LEVEL MAINTENANCE
CAPABILITY TO MEET SURGE REQUIREMENTS
FOR A RIW ITEM:
THE C/KC-135, C-141 INERTIAL NAVIGATION SYSTEM

A Thesis

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the
Degree of Master of Science in Logistics Management

By

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Captain, USAF

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GS-12

September 1976

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CHAPTER I

PROBLEM DEFINITION

Statement of the Problem

Air Force depot level maintenance is a highly industrialized activity performed by both in-house and contract sources. The cost of depot level plus lower levels of maintenance range from three to ten times the acquisition cost of military systems over a ten year life span (18:4). In fiscal year 1974 the Department of Defense was spending \$20 billion a year for maintenance (23:58). Cost pressures of this magnitude have forced the Department of Defense to have a high concern for the cost of maintaining its systems. Recently the DOD has initiated the use of Reliability Improvement Warranties (RIW) in an attempt to lower the life cycle cost of military systems by lowering their maintenance costs.

RIWs are long-term contracts restricting repair capability of warranted items to the contractor for the duration of the warranty period (14:9). RIWs have been advanced as a useful device to obtain improved reliability (in terms of greater mean time between failures (MTBF)) by providing the contractor a positive financial incentive to increase the MTBF through a fixed price warranty contract (14:2). These

warranties are applicable to new procurement as well as items that are already in the inventory (28). Important as the life cycle cost of equipment may be, it is not the only factor that must be considered in a maintenance policy. The DOD must also maintain the industrial base capability to respond to surge requirements for repair of equipment resulting from increased activity in times of emergency conditions (30:3).

The DOD has maintained the capability in its depot level organic maintenance facilities to respond to surge repair requirements and field repair capability for several reasons:

First, since a full wartime support capability was required, it was felt that only a government depot could be required and counted on to retain this reserve capacity at all times. Second, since government depot employees are not allowed to strike, critical support of weapons systems would be assured at all times. Third, since government depots are under full government control, they cannot refuse to do some work on the grounds that it is not economical, etc. [11:2].

Modern military hardware is highly complex and embodies advanced state-of-the-art technology in most cases. Time and money constraints often preclude the testing and analysis required to achieve high reliability. Consequently, military systems are frequently deployed in an unstable state (predisposed to early failure), and require extensive resources to operate and support (21:1). Air Force organic maintenance at depot level, supplemented by contract maintenance, has historically maintained the resources necessary to provide this support.

For existing inventory items, the question of maintaining a surge repair capability is not usually an onerous one because the RIW contract has historically been performed concurrently with alternate in-house repair (19:10). For new procurement, however, DOD does not develop in-house repair capability until long after the item has been introduced into the inventory. Thus, in these cases, in-house repair capability may be seriously delayed. As a result, the government loses direct control over the maintenance of a surge repair capability (24). In the event that an RIW contractor supporting mission-essential equipment could not respond to surge requirements, alternative repair sources would have to be developed to meet the surge (6). In-house depot level maintenance facilities may then be a prime candidate for consideration in meeting surge requirements. Given the possibility that a contractor could not fully respond to a surge requirement, an examination should be made of the impact of RIWs on depot level maintenance capability to respond to surge requirements (6).

Background

From an economic viewpoint, reliability improvement warranties offer benefits unobtainable from any other kind of procurement methodology (36:B7-B8). The objective of RIW contracts is to provide the contractor an incentive to design and produce more reliable equipment with high mean time between failures (MTBF) resulting in lower maintenance costs during field/operational use of the equipment (37:A-14). The

contractor is responsible for repair of all warranted items during the contractually specified warranty period, which is usually quite long (normally 2-6 years). During this time, the contractor is encouraged to implement no-cost (to the government) Engineering Change Proposals (ECPs) that will increase equipment reliability. Since the contractor has the responsibility for all equipment repair for a fixed price, the reliability improvement should increase his profits (14:5-10).

Close scrutiny of the defense dollar has placed greater emphasis on the Life Cycle Cost (LCC) concept for weapons systems acquisition and has stimulated increased interest in the fixed cost features of RIW contracts which would enhance this concept (21:5). One of the benefits attributed to RIWs is the minimal investment required by the government for initial support, since the contractor acquires test and repair equipment to provide all repair services during the warranty period for a fixed price agreed upon during contract negotiations. RIW usage may also reduce requirements for skilled military maintenance and support manpower (37:A-13,A-14). These anticipated benefits have created high level (Assistant Secretarial) interest in the applicability of RIW within the DOD procurement methodology (22:1). This interest has resulted in a profusion of activity within the Department to enter into RIW contracts (28). The criteria provided by DOD for selecting RIW candidates (22:6ff) does not include a need for self-sufficiency. This

need for self-sufficiency was identified by the Air Force Business Research Management Center (8:5) and the ARINC Research Corporation in criteria for selection of items for RIW developed for the Rome Air Development Center (2:37,61).

The first documented use of the reliability improvement warranty (then called Failure Free Warranty) by a military department was in 1968, between the Navy and Lear Siegler for the AJB-3 gyro (2:31). Since then, the Navy has completed six such reliability improvement warranties (35:17). Interest in the DOD has grown and culminated in an action memorandum from the Assistant Secretary of Defense (Installation and Logistics) calling for trial RIWs for the purpose of improving RIW guidelines and to provide a broad base of experience from which to assess the effect of RIW on item reliability (22:1).

The initial DOD guidelines for selecting items for RIW recognize that not all items are suitable for this kind of warranty. The items should be of such physical characteristics that it is possible to:

- a. Use air freight to ship the items between the using activity and the contract repair site. This is to preclude the requirement for an excessive spare parts pool to support the supply/repair pipeline.

- b. Determine that the failure of the item is not due to external causes. The item should be substantially self-contained, immune to sympathetic failure, and sealed to avoid unauthorized tampering.

c. Determine both the expected use and failure rates of the item as well as the actual use and failure rate (22:5-6).

In addition to the physical characteristics, economic factors to be considered in the selection of items for RIW are:

a. It should be possible to obtain the warranty at a price commensurate with the expected value of the work to be accomplished.

b. The equipment should be suitable for being contracted for on a fixed price basis.

c. There should be potential for both the government and the contractor to profit by the contract: there should be enough items; the contract should be of a long enough duration; and there should be a projected usage rate on the equipment that will provide a positive impetus to the contractor to make improvements on the items (22:5-6).

The Navy has found the RIW to be an effective tool for reducing life cycle costs (35:19). In one instance (the AJB-3 gyro), the Navy shows a two million dollar savings in overhaul costs versus the cost that would have been incurred for commercial overhaul (35:14). Deferral of purchase of repair equipment and data, as well as deferral of in-house training costs, are also cited among the advantages of an RIW contract (4:123). The economic aspects of RIWs cannot be denied, and the cost figures presented by exponents of the RIW concept can be compelling in promoting RIW usage.

However, Air Force Regulation 66-7, which implements DOD Directive 4151.1 (20 June 1970) and DOD Instruction 4151.11 (11 June 1973), establishes the requirement to maintain a viable, responsive in-house industrial base for repair of mission-essential equipment. This regulation requires that an organic production base capable of rapid expansion to support emergency operations be maintained. Specifically, the latest maintenance processes are to be used to "maintain a modern industrial base [30:4]" to cover the surge contingency, and this maintenance capability is to be maintained under direct control of DOD where the established chain of command provides flexibility for immediate response to changing environments that could not be approached in a contractual situation (11:2).

AFR 66-7 recognizes contract maintenance as an ". . . effective means of augmenting the organic capacity of the Department of the Air Force to accomplish maintenance of its material [30:4]," but explicitly states that contract maintenance "must not be permitted to degrade the timely attainment of required organic maintenance capability [30:4]." RIWs, however, have been specifically defined as warranties, not maintenance contracts (22:1). Nevertheless, RIWS function as maintenance contracts while they are in force, and the possibility exists that they could degrade the "timely attainment of maintenance."

Under the RIW concept there is a possibility that the contractor may not be able to respond to surge requirements.

The following clause from the F-16 acquisition contract illustrates the possibility of this point:

. . . the contractor shall not be liable for any time delays (associated with the performance of RIW provisions) if the failure to perform the contract arises out of causes beyond the control and without the fault or negligence of the contractor . . . [1:104].

This clause implies that the DOD cannot necessarily rely on the contractor's capability in the event of a wartime surge. Additionally, the Director of Procurement and Production at Warner Robins Air Material Area expressed the following concern:

To specify "operational use environment" for such a time period (3 to 5 years) also presents forecasting difficulty and could well be the preamble to a contractor's defense for failure to honor such a warranty should such conditions vary [5].

This was not a problem in the early Navy application, as RIWs were performed concurrently with organic repair. In the first contract, only one third of the gyro population involved was covered by the warranty (19:10).

In a briefing to Mr. Gansler (Office of Assistant Secretary of Defense, Installations and Logistics), Air Force representatives stated that, in the event of a war, the Air Force would rely on increasing spares buys and organic maintenance, as spares, Aerospace Ground Equipment (AGE), and data are optioned in the contract "to allow organic maintenance to come in anytime [7:2]." The preceding position implies that there is a reliance on organic

capability to respond to surge requirements. However, the effect of RIW contracting on the depot level organic maintenance capability is not presently known (17; 21). Within Air Force Logistics Command, DCS/Maintenance personnel have expressed considerable concern about the possible effect that RIWs will have on planning for wartime surge capability to support operational commands' mission readiness (10:1; 24:2). Having spares, AGE, and data optioned in the contract is a definite advantage because obtaining support equipment is the pacing factor in establishing organic repair capability. But, beyond that, training, moving the equipment, setting up the equipment, testing the equipment, and prototyping the repair process have to be completed prior to effective production (17).

Justification

Several studies have been accomplished on the RIW concept, concentrating on selection criteria, cost factors, and reliability improvement incentives (2; 8; 14; 25), but none of them substantively addresses the impact of RIW on the depot level maintenance surge capability. In one study, the surge requirement is acknowledged with an assumption that the contractor can handle any surge (14:45). Most of the studies referenced, however, have focused upon the cost and reliability incentives of RIW with little consideration of other matters.

Early RIW contracts covered items which were already in the inventory with existing organic maintenance capability

(15:39). The additional government stock items and this maintenance capability provided a redundancy for the warranted items and ensured the government a surge capability (19:10). The latest RIW contracts, however, cover 100 percent of the maintenance capability for each of the items. Under contract terms, the contractors maintain the test and repair equipment, which leaves them as the sole repair sources for the duration of the warranty period (2:24). This aspect of RIW becomes increasingly important, since the number of items procured under RIW agreements is increasing; the Air Force presently has eight components that will use the RIW concept (28).

RIWs only authorize organic maintenance facilities to remove/install and bench check malfunctions for warranted items; therefore, the government's support capabilities are minimal during the long-term warranty period (37:A-14). All RIWs to date have included provisions for transition of maintenance equipment (special tooling, technical data training, field support, and data accumulation and reporting) from contractor support to the buyer's support system upon warranty expiration. The transition of a proven design with all equipment in the same configuration with a provision for spare parts requirements documentation has reflected favorably upon the RIW concept (2:32), but the concept is still relatively new and not fully tested.

With the current trend of extending warranties at premature stages to more complex military equipment and

components, the Council of Defense and Space Industry Association (CODSIA) believes that "the burden of risk being passed to the contractor will become intolerable, and, in the long term, destructive of the best interests of national defense [13:A-22]." The government's total dependence on the contractor for repairs during the warranty period amplifies CODSIA's concern. The AN/ARN 118 TACAN Request for Proposal (RFP) also acknowledges the criticality of using a sole source repair facility by including the provision:

. . . the contractor shall make provision for at least one backup repair facility and secure storage area located at least five hundred (500) miles from the primary facility [34:50].

Consideration of surge support requirements is also reflected in AFR 800-21, which requires that "trade-off studies for evaluating effects on system operational readiness . . . are made . . . to justify the initial decision" to use interim contractor support. These trade-off studies include an "analysis of . . . war time implications; . . . contractor, organic, and interservice existing capabilities and expected reasonable growth of those capabilities . . . [33:3]." However, Mr. Reyvogel, USAF/LGYE, Office of Primary Responsibility for AFR 800-21, stated that RIW is not considered interim contractor support and AFR 800-21 does not apply to RIW (26). Although no support problems have been documented on RIW contract performance to date, a distinct possibility exists that contractors could be unable to perform under surge conditions. The capability to respond to

increased demands from operational activities in crises is singularly important in logistics. This capability to respond to surge requirements should not be overshadowed by economic considerations alone; therefore, this study will concentrate on the non-economic aspects of RIWs. Information gathered in determining the impact of RIWs on depot level maintenance capability to meet surge requirements will present an additional factor for consideration in the RIW procurement options. Without objectively examining the effects of RIW on surge capability, no counterpoint exists to compelling arguments to employ RIW contracts.

Research Objective

The theoretical aspects of Reliability Improvement Warranties are difficult to fault from an economic point of view. Unfortunately, the world is not single-dimensioned, and other aspects of DOD spares support also require consideration. In particular, the maintenance of a viable, responsive industrial base capable of responding to surge requirements in the event of a national emergency is important (30:3). The need to provide a rapid response to surge requirements is a primary reason for maintaining government owned and operated depot level repair facilities. The possibility exists that RIW contractors could not meet surge requirements. If such is the case, the impact that numerous RIW contracts would have on the capability for response to surge could be critically important. The objective of this research is to evaluate the effect that solely supporting the

KC/C-135/C-141 Inertial Navigation System (INS) with RIW up to D-Day could have on Air Force depot level maintenance capability to support surge repair requirements for the INS.

Definition of Terms

D-DAY--First day of national emergency.

ITEM ACTUAL REPAIR HOURS--Number of hours required to repair a specific item at a specific time.

LEARNING CURVE--A projected decrease in time required to repair an item as the number of items repaired increase. The mathematical expression of the learning curve is $Y = KX^n$ where Y is the time required to repair the X^{th} item; K is the time required to repair the first item; X is the unit number; n is $\log B \div \log 2$ where B is the nominal value of the learning curve.

ORGANIC DEPOT LEVEL MAINTENANCE--Maintenance by government owned and operated depot level repair facilities--specifically, Air Force depot level repair at Ogden, Oklahoma City, Sacramento, San Antonio, and Warner-Robins Air Logistic Centers (ALCs), and the Aerospace Guidance and Metrology Center (AGMC).

REPAIR CAPABILITY--Capability (expressed in number of items) of contractor/depot level organic maintenance to repair items per unit of time.

SPECIAL EQUIPMENT--Equipment that is peculiar to the repair and/or test of an item. This equipment is not

normally possessed by a repair facility unless that facility is programmed to repair the item.

STANFORD B FACTOR--A factor used to modify the learning curve to account for an organization's previous experience in performing similar work.

SURGE REQUIREMENTS--The time-phased unit requirements (by maintenance priority) generating from D-Day as projected by item requirement computation.

TECHNOLOGY REPAIR CENTER--Organic depot level repair facility responsible for repair of items in specific technologies.

TIME-PHASED--Daily phasing of data.

Study Approach

A simulation study approach was used to address research questions concerning required and available maintenance surge capability, since data available for RIW items are limited (28) and actual data could only be obtained in the event of a national emergency. In this study, depot level organic maintenance capability required to complement RIW contractor repair capability for a selected weapon system component was evaluated at each of three assumed levels of contractor performance. The three selected levels of contractor performance and the rationale for each are as follows:

1. The contractor will continue repair activity at 100 percent of contract specified levels. This level of

activity is considered since the item is on contract for this level of repair.

2. The contractor will increase repair performance to 150 percent of specified levels (number of items repaired). This level of performance was derived by expanding the regular 40 hour work week by an additional 20 hours. The assumption is made that increasing overtime beyond this level will result in diminishing returns that will affect the gains made by the additional overtime. Another assumption necessary here is that excess contractor capacity is available and can be purchased by the government. The cost of purchasing the additional contractor capacity will not be addressed.

3. The third level, where the contractor ceases repair, is based upon the possibility of his being physically or economically prevented from performing the contracted repair. This possibility was discussed in the background information for this study.

Research Questions

The primary research question which was addressed in this study is as follows:

In the event of a national emergency, could repair capability be developed that would be sufficient to meet time-phased surge requirements for an item that had been supported solely by RIW up to D-Day?

The following questions were addressed to answer the primary research question:

At each of three different levels of contractor performance in a national emergency, would repair capability above the assumed level of contractor performance be required?

What time-phased level of depot level organic maintenance capability could be developed starting at D-Day?

Would the generated maintenance capability be sufficient to cover surge requirements in excess of contractor performance at each of the three assumed levels?

CHAPTER II

METHODOLOGY

Overview

A simulation of the maintenance support from the RIW contractor and organic depot level maintenance for the inertial navigation system (INS) applicable to the C-141 and C/KC-135 aircraft was conducted to determine if sufficient repair capability could be developed to meet anticipated time-phased surge requirements. These anticipated surge requirements for the INS were obtained from AFLC/Material Requirements Branch (MMR) based on USAF logistics planning factors and were compared to the contractor's repair capability at each of the three assumed performance levels previously described. If there were requirements that could not be filled by the contractor, another source of repair would have to be employed to fill the resulting deficit. Since organic maintenance facilities are under government control, they can be required and counted on to develop repair capability; therefore, only the development of depot level organic maintenance capability was addressed. The time-phased development of this organic repair capability was projected on the basis of the number of personnel which could be made available to the INS repair facility on D-Day, projected organization/personnel learning curves, equipment

delivery, set up times, equipment testing, and parts and data support availability. The repair capability thus obtained was then compared to the requirements which exceeded contractor capability at each of the assumed levels of contractor performance.

Item Selection

The initial step in the study was to select an item that will be or could be completely supported by RIW up to D-Day. Weapon system components projected for or currently covered by RIW contracts were identified by the Air Force Logistics Command Contract Maintenance and Management Branch (AFLC/PPMM). They are: klystron tubes under contract with Varian Associates, the C-141 C/KC-135 INS under contract with Delco Electronics, the C-130 hydraulic pump under contract with ABEX, and the 118 TACAN under contract with Collins Radio (16). These components were screened against the following criteria:

1. It meets RIW selection criteria as outlined in the USAF Interim RIW Guidelines (31).
2. It is designated mission-essential by AFR 66-7.
3. Data concerning its maintenance surge requirements and repair requirements (equipment, man-hours, skills, etc.) were available.

The klystron tubes were rejected on the basis of limited repair action applicable to them. The hydraulic pump was rejected because it is applicable to a test restricted to a relatively small number of C-130s, and capability to

support requirements for the pump is readily available from in-being alternate repair capability. The 118 TACAN was rejected on the basis of the existence of alternate support from substitutable items. The INS was selected as the subject of this study on the basis of meeting the criteria previously listed.

Surge Requirement Source Data

The surge requirements necessary for this study were obtained from AFLC/MMR (3). They were based upon official USAF planning factors and time-phased (projected monthly requirements for a wartime scenario) from D-Day for a period covering two years (see Table II-A). The demands are highest for the first three months with requirements of 258 units per month if the proposed MTBF and INS operating hours are attained. The demands drop to 229 per month for the next three months, then 226 demands per month are generated over the remaining period. The assumption necessary here is that the surge requirements established by AFLC/MMR personnel are representative of requirements which would be generated in a wartime situation.

Item/Contract Repair Source Data

The INS selected for the study is being procured under Air Force contract FD2060-75-64210(C) from the Delco Electronics Division of General Motors Corporation, Goleta, California (29:1). Since this is a recent procurement action (29:1), there is no historical data on this INS. Maximum

procurement options would result in 1,289 installed INSs: 275 modified C-141s with a quantity per application (QPA) of two and 739 C/KC-135s with a QPA of one (29:1.2.11,E.1.III). The operating hours per month of the installed INSs are estimated to be 160 when installed on a C-141 and 55 when installed on a C/KC-135 (29:3.1). The operating hours are computed at 1.5 times the estimated actual flying hours (29:5.4).

Delco Electronics guarantees that the INS will achieve an average mean time between failure (MTBF) of 1,128 operating hours (29:1.2.4). The expected number of repair actions per month that must be accommodated under the RIW provision of the contract is computed by adding the product of the number of INSs installed on C-141s times the C-141 INS operating time per month to the product of the number of INSs installed on C/KC-135s times the C/KC-135 INS operating time per month, then dividing the sum by the MTBF as follows: $((550 \times 160) + (739 \times 55)) \div 1128 = 114$. Therefore, the contractor must be prepared to repair 114 INSs per month under the terms of the contract.

In addition to the units installed on aircraft, additional INS spares are required to fill the transportation and repair pipelines. The stockage objective for these spares was assumed to have been filled; that is, the number of spare units that should be purchased to support the INS program are assumed to have been purchased and delivered prior to D-Day. The total stockage objective of 283 units consists

of a base level order and shipping time requirement of 46 units, base safety level requirement of 123 units, and depot safety level of 114 units. These stock level computations were validated by AFLC/MMR based upon contract data (9) and account for world-wide Air Force spare assets. When these assets are exhausted, unfilled requisitions result in aircraft not fully equipped.

Monthly surge repair requirements were also computed by AFLC/MMR based on contract data heretofore cited and the Industrial Preparedness Program, dated 23 April 1976 (3; 32). These repair requirements were projected for a worst case scenario.

The simulation program converts the month's repair demands to daily demands based on a poisson distribution. The assumption is made that the demands for INS repair will follow a poisson distribution with a mean of the average daily demand (derived by dividing the month's demand by thirty days). No data exists to determine the appropriate distribution of demands for this INS. However, the poisson was chosen to introduce variability, which could reasonably be expected to exist in an actual maintenance surge situation. The effect of this variability on the extremes of the number of unfilled requirements for a particular day and on the number of days that a stock-out position exists, would not be reflected by a purely deterministic model.

To determine the effect that the contractor's failure to achieve the guaranteed MTBF would have on the simulation,

Data were constructed that would be applicable in the event that an MTBF of 500, 750, or 1,000 hours was realized. These data are summarized on Table II-A and were used in additional simulations.

Table II-A
Data Applicable to Different MTBF Levels

MTBF	500	750	1000	1128*
Stock Level	545	391	311	283
Contract Repair Level	257	171	129	114
Demands for Months				
1-3	582	388	291	258
4-6	516.6	344.4	258.3	229
7-24	509.9	339.9	254.9	226

*Contract guaranteed MTBF. Remaining figures in this column are based upon contract data.

Organic Repair Source Data

Organic depot level repair can begin upon receipt of special equipment and repair data. To determine the number of items that organic depot level maintenance can repair each day, the number of hours of maintenance capability available was divided by the time required to repair the xth item. The hours of capability available were determined by multiplying the number of personnel by an availability factor which accounts for non-duty time such as sick leave and annual leave. The time required to repair the xth item was determined by the learning curve and availability of special

repair and test equipment, and repair data. The interaction of these variables along the time continuum determines the number of items that can be repaired during any particular day. Projections of the number of personnel available, the availability factor, the shape of the learning curve, and the receipt date of special equipment and repair data were obtained from the applicable AFLC source as outlined in the following paragraphs.

The Aerospace Guidance and Metrology Center (AGMC), Newark Air Force Station, Ohio, was identified as the most likely organic repair center for the INS (6). Personnel from the Work-Loading and Field Services Branch (AGMC/MAWW) provided estimates of organic repair data which follow (12). Under the assumptions of continuing contractor performance, AGMC personnel anticipate that organic repair capability can be initiated at the end of 91 days. The 91 days results from plans to conduct training of in-house personnel at the contractor overhaul site and moving and setting up depot aerospace ground equipment (which AGMC assumed will be available from the contractor) following the training period. Under the assumption of no contractor repair, it is assumed that the special repair equipment and data can be made available to the organic repair activity immediately, and organic repair can begin at D-Day.

Standard repair time is the time that a fully qualified and trained technician requires to repair an item when working at an efficient, normal pace. Standard repair time

includes an allowance for personal rest and delay (coffee breaks, restroom, etc.). These times are based on the average expected occurrence of repair operations, since all repair operations are not performed 100 percent of the time. The standard repair time of the INS was estimated to be 125 direct labor hours. Sixty-eight percent of the time, the repair time is estimated to be between 100 and 150 standard direct labor hours (accounting for a smaller or a greater occurrence rate of repair operations than is included in the 125 hour standard), which yields a standard deviation equivalent to 20 percent of the standard repair time. The 20 percent standard deviation was used in an approximated normal distribution to introduce variability into the time required to repair an item. The variation about the mean time to repair an item occurs when that item requires either more or less than the average standard time to return it to a serviceable condition. For example, only a minor adjustment may be required, or only testing may be necessary (the field activity may erroneously identify an item as failed even though it is serviceable), or an extensive troubleshooting and repair procedure may be followed (as in the case of a massive failure). Introducing the variability into the required item repaired time, as in the daily demands generated by the simulations, will not substantially affect the average time to repair an item, but will affect the extreme values--the number of unfilled requirements for a particular day and the number of days that a stock-out position exists.

The assumption was made that repair times would follow a normal distribution.

The Stanford B Factor and the learning curve describe the effect of repetition on the actual time required to perform a task. A task is not performed as efficiently the first time as it is the second time due to the learning that takes place during the previous time that the task was performed. A 90 percent learning curve shows that the time to accomplish a task reduces to 90 percent of the time required at the previous point every time the number of times that the task is performed is doubled. That is, if the initial task performance required 100 actual labor hours, the second will require 90 hours; the fourth will require 81 hours; and the eighth will require 72.9 hours. The difference between the actual and standard repair time is termed "labor efficiency" and is derived from the ratio of standard hours to actual hours: labor efficiency is equal to standard hours divided by actual hours. The slope of the learning curve is steep as the first tasks are performed and flattens out as the number of times that the task has been performed increases.

A transfer of learning from a similar task results in the first time to accomplish the task intercepting the learning curve where the learning curve slope is shallower than would otherwise be applicable. The Stanford B Factor is introduced into the learning curve formulation to account for this variance. The Stanford B Factor of 7.3343 and learning curve value of 87.54 percent used in this study

were based on the following estimates: 60 percent direct labor efficiency for repair of the first item following training, 90 percent direct labor efficiency for repair of the 60th item following training, and 40 percent direct labor efficiency for repair of the first item with no training. Detailed development of the Stanford B Factor and the learning curve value is provided in Appendix A.

The number of direct labor personnel available for organic repair in each of the assumed cases of contractor response to the surge requirements (reference Table II-B) was provided by AFLC/MAX (27).

Table II-B
In-house Personnel Availability

Contractor Response Percentage	100	150	0
In-house Personnel Available for Surge	83	56	166

Simulation Program

The simulation program was written in Fortran Y machine language compatible with the Honeywell 635 based CREATE system operated by the Air Force Logistics Command at Wright-Patterson AFB. The program consists of three major blocks of instruction which load the program with the required data, introduce a stochastic element to the daily demand rate that is derived from monthly projections, and compute contract and organic repair quantities and stock level. The program logic was developed on the following

pattern: the day's demand is subtracted from the stock on hand and added to the number of reparable items. The number of items that can be repaired by the contractor is then subtracted from the reparables. The contractor repaired items are added to the stock on hand. If any reparables remain after contractor repairs, the number of items that can be repaired by the organic facility is subtracted from the remaining reparables. The organic repaired items are also added to the stock on hand. The results for the day are printed and a computation for the next day begins.

The day's demand is determined by first dividing the projected monthly demand by thirty to yield the average demand per day for the current month. A system generated random number is then used to select a demand from a matrix loaded with demand levels and their associated cumulative poisson probability distribution. The program loads the matrix with the appropriate demand level and probability distribution according to the average day's demand rate. Due to the factorial in the poisson computation exceeding the system's numerical capability, a normal approximation of the poisson is used for average daily demand rates which exceed 13. This approximation is accomplished with a discrete approximation of the normal $(0,1)$ distribution which is loaded in the program.

Following the computation of the day's demand for each of the thirty days in each of the twenty-four months, a heading is printed for the month (which is subsequently

repeated twenty-three additional times). The first phase of the daily computations is to determine the day of the week. This determination is necessary as the simulation assumes that the contractor will perform no work on Saturday, and neither the contractor nor the organic facility will perform work on Sunday. The demands previously computed are indifferent to the day of the week. Stock on hand at the beginning of the day equals the stock on hand at the end of the previous day (stock on hand at the beginning of day 1 is loaded into the program). The number of reparable for the beginning of the current day is computed by adding the current day's demands to the number of reparable remaining at the end of the previous day.

The contractor's daily repair rate is set at the contract monthly repair level divided by 22 (average working days) for the first version, which assumes continued contract support at the contracted level; by 14.67 in the second version, which assumes contract support at 150 percent of the contracted level; and is set to zero for Saturdays, Sundays, and the third version, which assumes no contract support. The day's number of reparable is compared to the contractor's support level for the day to determine the number of items repaired by the contractor. If the contractor has sufficient capability remaining to start, but not finish, an item, that item is put into work and completed with the first subsequent day's contractor capability. The number of reparable is reduced by the number of items repaired plus any items put

into work on the current day but not repaired. Stock on hand is increased by the number of items for which repair has been completed.

After assessment of the contractor's support effect on the asset levels, the program checks the day of the week. If it is Sunday, the day's computations are complete and the results are printed. If it is not Sunday, a determination is made as to whether or not all equipment that is critical to organic repair has been received by the organic repair facility. If not, the day's computations are complete. If the critical items have been received, receipt of noncritical items is then checked, and the first item repair time is modified by the effect that receipt of these items will have (receipt of specialized tools and/or data is expected to reduce the repair time by a specified percentage). The program then checks to determine if there is any work to be accomplished. If there is no work remaining to be done, the day's computations are complete. If there is work to be accomplished (either completion of an in-work item being held at the organic repair facility or additional reparable or both), the number of hours of organic capability for the day is computed. This capability is first applied to repair of an in-work item. If capability is still available, a reparable is put into work; and the number of reparable is reduced by one. The expected time to repair the item just put into work is computed according to a specified learning curve value and the number of the item entering organic

repair (first, second, etc.). A system supplied random number is then used to compute the deviation from the expected repair time based on an approximation of the normal (0,1) distribution times a prespecified percentage of the expected repair value. That is, if the repair time is expected to be within \pm 10 percent of the mean value 68.26 percent of the time, the randomly selected value of the deviation from the normal (0,1) distribution is multiplied by 10 percent of the mean time to repair the item. The actual repair time thus determined is then compared to the remaining organic repair capability. If the item can be completed, stock on hand is increased by one, and the cycle is repeated for the next reparable. If the item cannot be completed, the item remains in process at the end of the day. When either the organic repair time available or the number of reparables is exhausted, the day's computations are complete, and the results for the day are printed. Thirty days are computed for each month, and 24 months are computed. A description of the program variables and the program coding are included in Appendix B.

Criteria Test

Legal and economic factors cited in the background information and disruptions in production that could result from establishing priorities for the performance of defense contracts under the Defense Production Act (28:195) made projections of contractor's response in a national emergency outside the scope of this paper. Therefore, the contractor's

response in a national emergency was assumed to be at each of the three previously identified performance levels in the development of the criteria test of the primary research question. The anticipated requirement was compared with each of these levels to determine the additional repair capability, if any, that would be required to totally support the surge.

By matching the time-phased surge requirements to each of the three levels of contractor response and the time-phased development of organic depot level maintenance capability, it was possible to determine if any time frames contained unfilled surge requirements. If the projected depot level organic repair capability could fill requirements excess to contractor performance for the INS (no stock-outs existed), combined contract and organic maintenance capability would be sufficient to maintain support required in the surge situation. Failure to fill a requirement would result in an aircraft not fully equipped.

List of Assumptions

Summary list of assumptions made in the methodology:

1. The contractor will perform at one of three levels of repair:
 - a. Contractor performs at specified contract level.
 - b. Contractor performs at 150 percent of specified contract level.

c. Contractor cannot support any contract requirements.

2. Anticipated surge requirements obtained from AFLC are representative of requirements that will be generated in an emergency situation (wartime scenario).

3. Selected item will be supported exclusively by RIW contractor up to D-Day.

4. Alternative repair sources for the RIW item would be subject to the same limitations in developing a repair capability for that item.

5. Projected time-phased organic maintenance repair capability is valid for an emergency situation.

6. Pipeline times for organic and contract maintenance are the same.

7. Failure to support a requirement will result in an aircraft not fully equipped.

8. Increasing the contractor's repair performance over 150 percent of contract specifications would result in diminishing marginal returns.

9. Appropriate repair equipment and data could be immediately transferred to the in-house repair facility in the event of no contractor performance. The assumption necessary here is that the Air Force would recognize prior to D-Day that the contractor would be unable to perform.

10. Initial stock level for the INS would be at the levels indicated by AFLC computations for requirements.

11. The contractor would not work on Saturday or Sunday. The organic repair facility would not work on Sunday.

12. Demands for repair would generate in a poisson distribution.

13. Organic maintenance repair times would follow a normal distribution.

14. Special equipment and data are available from the contractor and can be in place on the 91st day when the contractor continues repair following D-Day and can be in place immediately when the contractor ceases repair.

Limitations

The results of the comparisons performed in this study are uniquely applicable to the selected RIW item and depend upon the stated assumptions. It is not appropriate to generalize the test results to any other item or class of items. The intent of the study was to determine the possible impact that relying solely upon an RIW for maintenance support would have on capability to meet increased requirements which would generate in the event of a national emergency.

CHAPTER III

FINDINGS

Introduction

The simulation results for this study will be presented, based upon the MTBF and contractor performance level for each of the twelve simulations that were completed. Major emphasis will be placed upon the three primary simulations, which were based upon the contract specified MTBF of 1,128 hours for the INS and contractor repair capability at 100 percent, 150 percent, and 0 percent of the contract specified performance levels. Data from these simulations are graphically displayed in Figures III-A, III-B, and III-C to present a comparison of contractor plus organic repair capability with demands that were generated by the simulation. Although the simulations covered a 24 month period, only portions of this time frame were needed to develop the trends portrayed in these figures. The initial stock on hand for INS spares is plotted with contractor repair capability for the simulations in which contractor repair was a factor, and with organic repair capability when contractor performance was 0 percent. The data plotted are end-of-month figures that graphically display the length of time that total repair capability will be less than the INS demands for repair, as

well as the number of INS units that will not be supported by repairs or initial spares. Summary statistics for the nine simulations based upon reduced MTBFs of 1,000, 750, and 500 hours and the three contractor performance levels of 100 percent, 150 percent, and 0 percent are given in Tables III-D through III-H. Selected computer printouts for each simulation are presented in Appendix C.

Guaranteed MTBF: 1,128 Hours

Contractor performance = 100 percent. Under this assumed level of contractor performance, no organic repair could be generated until D-Day plus 91 days due to training and receipt of equipment. The initial stock on hand of 283 INS units plus the contractor repair satisfy demands that are generated until the third day of the third month, which is one month prior to organic repair being initiated. The INS shortages increase to a maximum of 165 units, which is experienced during the fourth month, then steadily decrease after organic repair begins. Total repair capability is sufficient to satisfy demands once again on the 29th day of the sixth month (see Figure III-A). The trend shown by the graphic portrayal indicates that the stockage objective of 283 spare INS units can again be filled by using both organic and contractor repair, while contractor repair only would result in a steadily increasing number of non-supported INS units. Table III-A gives a summary of the end-of-month data plotted in Figure III-A.

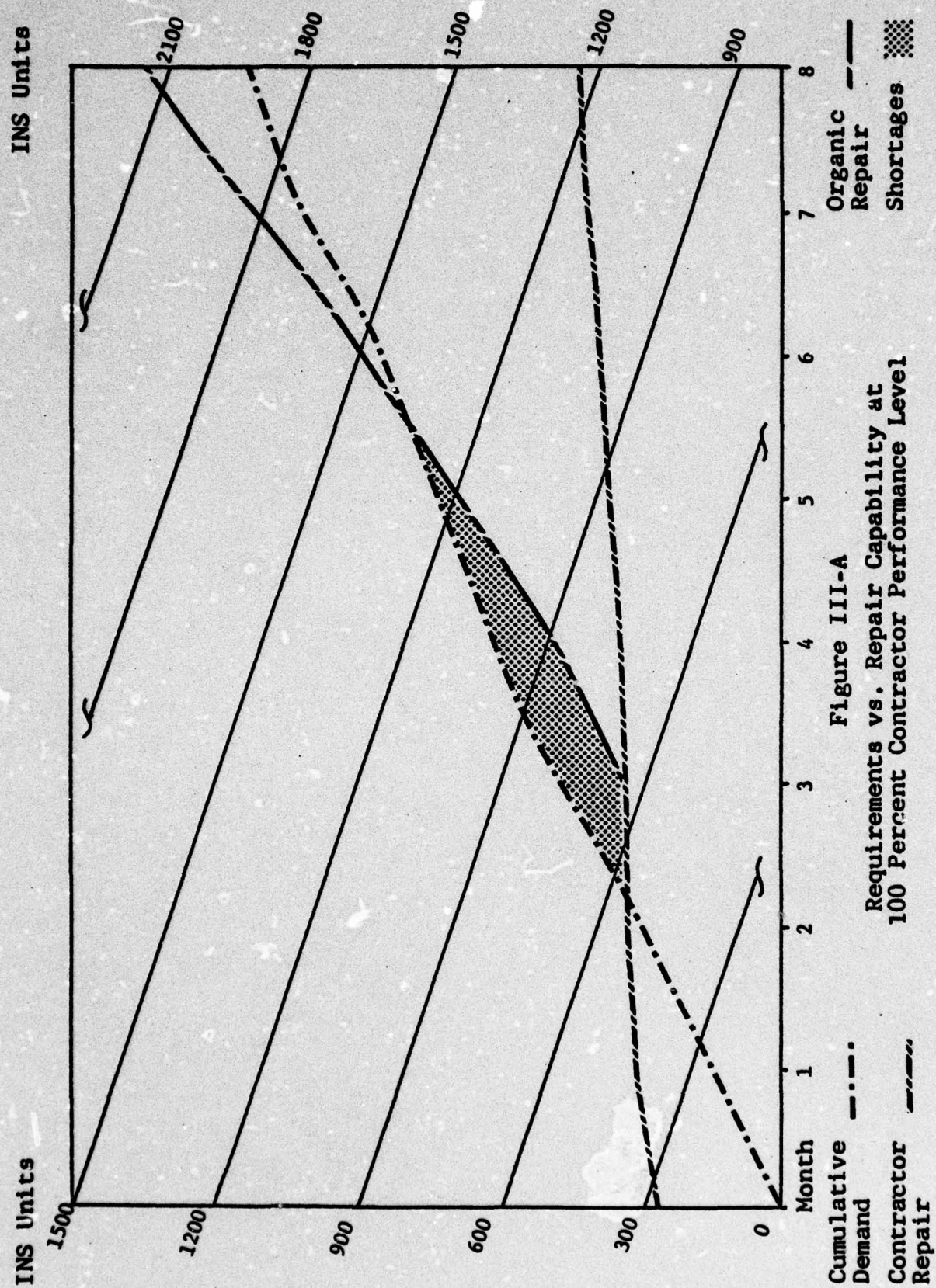
Table III-A

Requirements vs. Repair Capability
MTBF = 1,128 Hours
Contractor Performance = 100 Percent

Month	Monthly Demand	Total Demand	Cumulative		Total Repair	Unrepaired* Units	Shortage**
			Contractor Repair	Organic Repair			
1	249	249	121	0	121	128	0
2	266	515	242	0	242	273	0
3	278	793	357	0	357	436	153
4	213	1006	473	129	602	404	165
5	230	1236	594	302	896	340	114
6	246	1482	715	496	1211	271	55
7	244	1726	825	699	1524	202	0
8	216	1942	946	927	1873	69	0

*Total demand minus total repair.

** Initial stock on hand minus unrepaired units. Figures indicate maximum INS units short per month.



Contractor performance = 150 percent. With the assumption of 150 percent contractor performance and 283 initial spare INS units, repair support was sufficient to meet demands until the 28th day of the third month. Table III-B indicates a shortage in the third month. Shortages are incurred through the last day of the fourth month. Organic repair was again initiated on the 91st day of the simulation. This organic repair plus the increased contractor performance decreased the time interval of INS unit shortages to approximately one month and the maximum number of shortages at any given time to only thirty units. As with the initial simulation, contractor support only would result in a steadily increasing number of non-supported INS units (see Figure III-B), but the difference would be smaller in this case due to the increased contractor repair.

Contractor performance = 0 percent. Under the assumption of no contractor support the organic facility begins repair at D-Day and maintains sole support of the INS throughout the 24 month simulation. The initial stock on hand of 283 INS units plus the organic repair that can be generated maintain repair support for the INS with no days of shortages (see Figure III-C). Table III-C further shows that only two months end with "Unrepaired Units." This means that the stockage objective of 283 spare units was maintained with few of the spares unrepaired at any given time, or that demands were covered by organic repair sufficiently without depleting the spares.

Table III-B

Requirements vs. Repair Capability
MTBF = 1,128 Hours
Contractor Performance = 150 Percent

Month	Monthly Demand	Total Demand	Cumulative			Unrepaired* Units	Shortage**
			Contractor Repair	Organic Repair	Total Repair		
1	255	255	165	0	165	90	0
2	265	520	330	0	330	190	0
3	267	787	487	0	487	300	17
4	222	1009	645	81	726	283	30
5	214	1223	810	187	997	226	0
6	229	1452	975	306	1281	171	0
7	218	1670	1125	429	1554	116	0
8	219	1889	1290	567	1857	32	0

*Total demand minus total repair.

**Initial stock on hand minus unrepaired units. Figures indicate maximum INS units short per month.

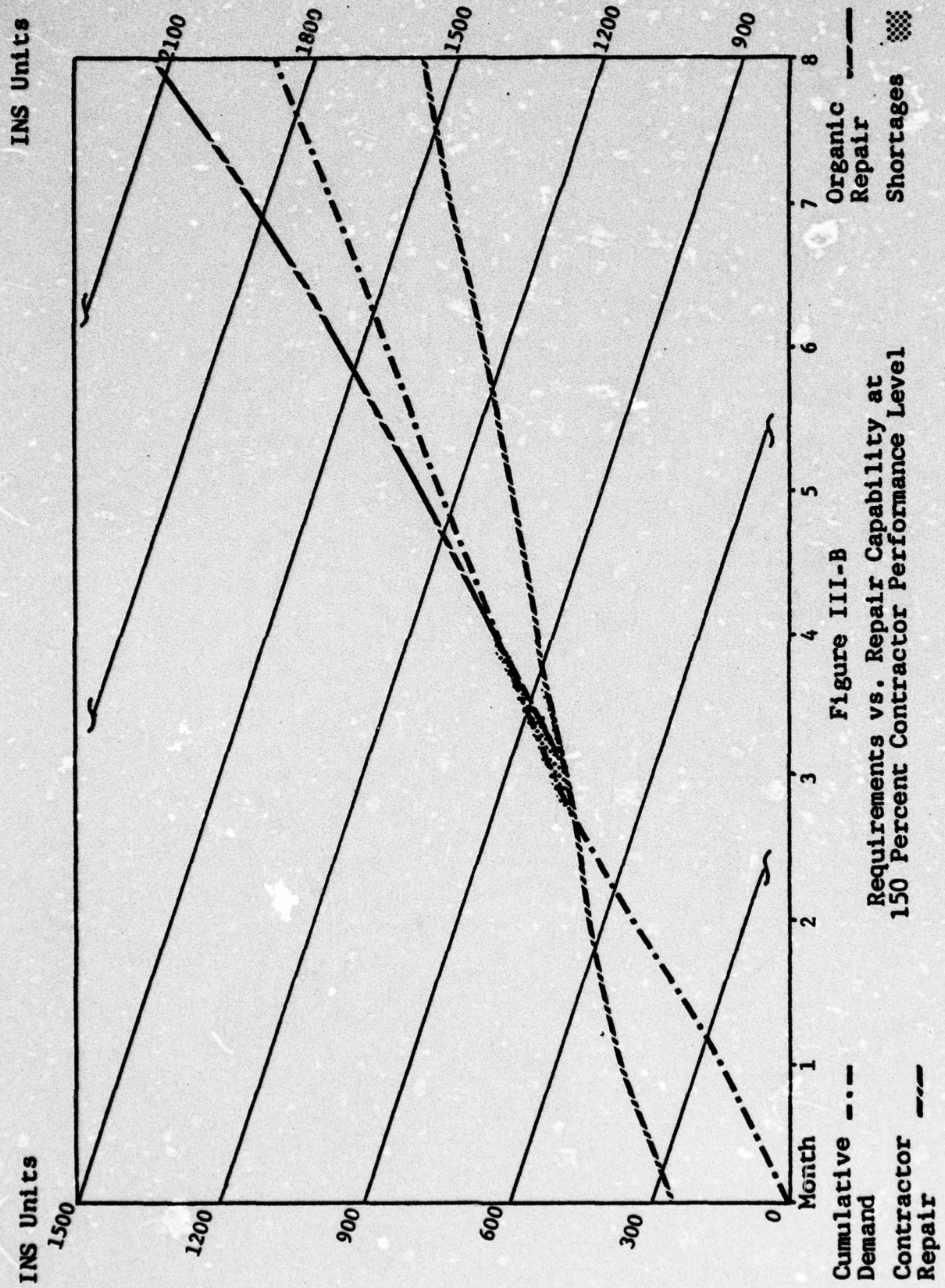


Table III-C

Requirements vs. Repair Capability
 MTBF = 1,128 Hours
 Contractor Performance = 0 Percent

Month	Monthly Demand	Total Demand	Cumulative		Total Repair	Unrepaired Units	Shortage**
			Contractor Repair	Organic Repair			
1	242	242	0	242	242	0	0
2	283	525	0	525	525	0	0
3	262	787	0	787	787	0	0
4	249	1036	0	1030	1030	6	0
5	254	1290	0	1290	1290	0	0
6	247	1537	0	1537	1537	0	0
7	222	1759	0	1748	1748	11	0
8	230	1989	0	1989	1989	0	0

*Total demand minus total repair.

** Initial stock on hand minus unrepaired units. Figures indicate maximum INS units short per month.

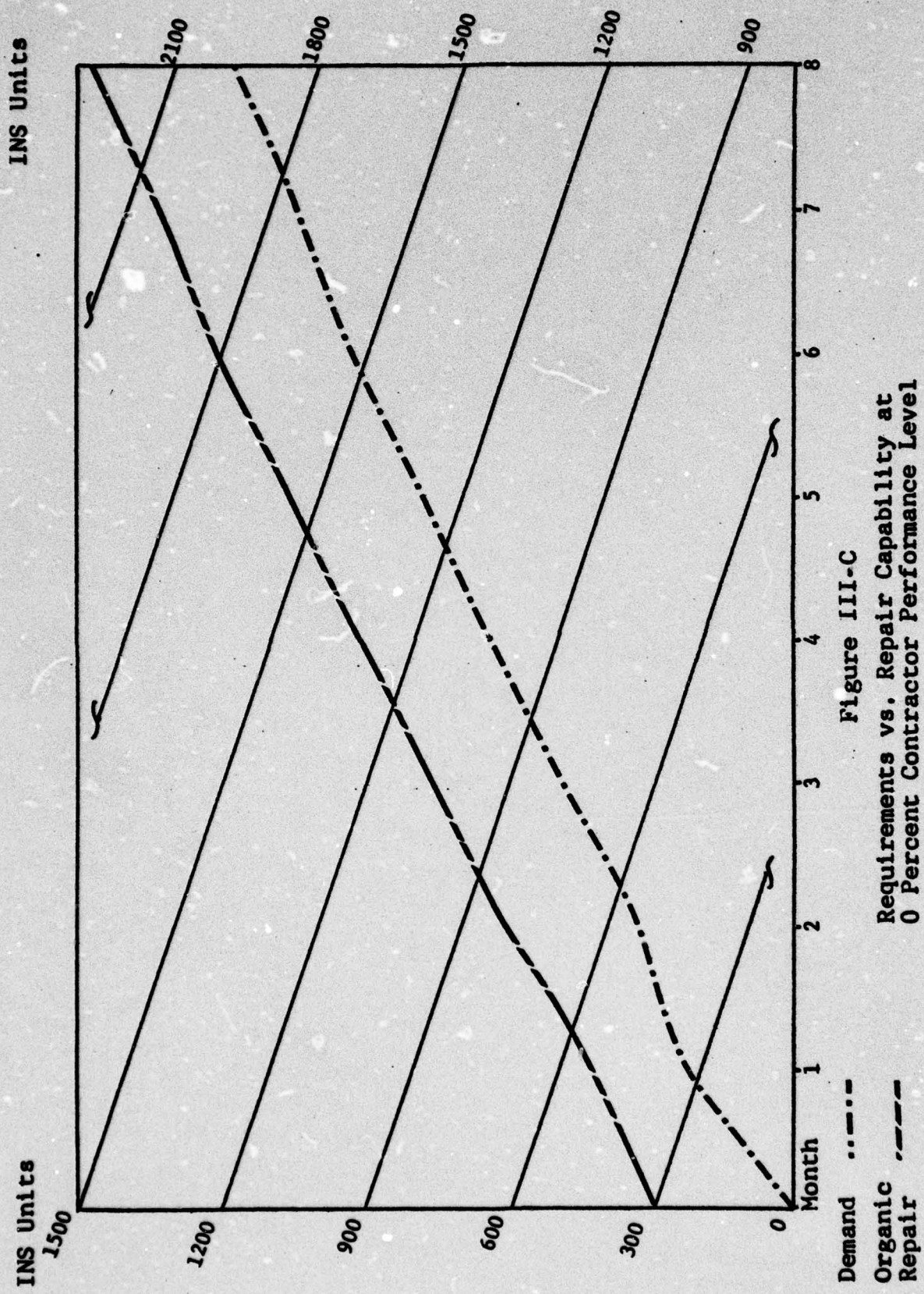


Figure III-C
Requirements vs. Repair Capability at
0 Percent Contractor Performance Level

Reduced MTBF: 1,000 Hours

Contractor performance = 100 percent. Repair support changed slightly from the primary simulation based upon 1,128 hours MTBF. The initial spare support was recomputed for 1,000 hours MTBF as 311 units. The length of time with shortages increased by one month (beginning on day five of month two and ending on day 25 of month seven), and the maximum number of INS shortages increased by six to 174 (see Table III-D).

Contractor performance = 150 percent. The 311 initial spare INS units were again used under this assumption. Shortages were incurred during the third month and continued through the 26th day of the fifth month. The maximum number of INS shortages causing mission degradation at any given time was 25. The variability introduced into the simulations produced this two and a half month period of shortages with 25 as the maximum number of shortages, while at the same contractor performance level and a better MTBF of 1,128, the length of time of shortages was one month less and the maximum number of shortages was 30. The greater MTBF would normally produce the better results.

Contractor performance = 0 percent. The 311 INS spares plus the organic repair that can be developed was sufficient to meet the demands with no shortages (see Table III-D). The demands were met by the organic repair and the

stockage objective was maintained at or near the 311 units required.

Table III-D

Maximum INS Unit Shortage per Month
MTBF = 1,000 Hours

Month	Contractor Performance Level		
	100%	150%	0%
1	0	0	0
2	0	0	0
3	150	21	0
4	173	25	0
5	174	12	0
6	142	0	0
7	77	0	0
8	0	0	0

Reduced MTBF: 750 Hours

Contractor performance = 100 percent. The stockage objective was again computed for 750 hours MTBF as 391 units. These spares plus the repair capability that could be generated maintained support of the INSs without mission degradation until day 27 of the second month. There were approximately twelve months in which INS units were not available for required missions (seven months produced shortages over 200 units). The maximum number of units short at any given time was 274 units, which occurred during the fifth month (see Table III-E).

Contractor performance = 150 percent. Under this assumption, the 391 initial spares plus repair capability support mission requirements until the 12th day of the third month, then shortages increase to a maximum of 182 units during the fifth month. (see Table III-E). The shortages exist throughout seven months of the simulation with over a hundred units short for six of those months.

Contractor performance = 0 percent. The initial stockage objective of 391 INS units support plus the organic repair capability furnished 100 percent mission support (see Table III-E). Although the repair capability developed by the organic facility does not meet demands as they arise, the maximum reduction of spares is slightly over 100 units, and these units are eventually repaired and replaced.

Table III-E

Maximum INS Unit Shortage per Month
MTBF = 750 Hours

Month	Contractor Performance Level		
	100%	150%	0%
1	0	0	0
2	24	0	0
3	228	114	0
4	264	167	0
5	274	182	0
6	269	173	0
7	260	134	0
8	266	114	0
9	241	75	0
10	195	36	0
11	153	0	0
12	65	0	0
13	0	0	0

Reduced MTBF: 500 Hours

Contractor performance = 100 percent. When the INS MTBF was lowered to 500 hours, mission degradation in the form of INS unit shortages appeared during the second month (see Table III-F). The computation of the stockage objective at 500 hours MTBF shows that 545 spare INS units would be required. This MTBF is less than half the MTBF guaranteed by the contractor and yielded undesirable results for the simulation. Shortages continued throughout the simulation after the first month with the maximum number of 1147 units short during the 16th month (see Table III-F). The three months' printouts in Appendix C show the trend developed in this simulation, which revealed the worst results of any of the simulations.

Contractor performance = 150 percent. The situation improves somewhat under this assumption. The increased contractor performance plus the 545 spares support the INS without shortages until the third month (see Table III-F). The simulation reveals over eight and a half months with shortages, with a maximum number of 213 shortages during the sixth month.

Contractor performance = 0 percent. Again, the 545 spares and repair support delayed any shortages until the middle of the third month (see Table III-F). In this simulation, shortages were encountered through five months, with a maximum number of 111 units in the third month. The

average number of shortages for this simulation at 500 hours MTBF was lower than the previous two which had contractor support, and the duration of the shortages was less.

Table III-F

Maximum INS Unit Shortage per Month
MTBF = 500 Hours

Month	Contractor Performance Level		
	100%	150%	0%
1	0	0	0
2	139	0	0
3	473	62	53
4	621	121	100
5	744	190	93
6	833	213	111
7	874	202	98
8	951	178	52
9	1056	180	0
10	1096	153	0
11	1099	146	0
12	1092	96	0
13	1110	43	0
14	1115	23	0
15	1128	0	0
16	1147	0	0
17	1144	0	0
18	1105	0	0

Summary Statistics

Tables III-G and III-H provide an overall summary of the data for the twelve simulations. Table III-G shows the number of install-days that are not supported in each of

the twelve simulations that were run. An install-day is a unit expressing the installed INS for one day. There are 928,080 install-days requiring support during the 24 month simulation (1,289 installs times 720 days). Thus, the quantity and duration of unfilled requirements can be expressed. The percentages of non-supported install-days of the total 928,080 required are also provided in Table III-G. Table III-H provides the average effect that non-supported install-days have on aircraft fully equipped rates for the months where there are non-supported install-days. These percentages are derived by dividing the total number of install-days by the product of the number of months in which non-support occurred times thirty days times 1,289 installs.

Table III-G
Non-supported Install-Days

MTBF	Contractor Response	0%	100%	150%
500		10,159 1.09%	600,000 ⁺ 65.0%	36,399 3.92%
750		0 0%	57,169 6.16%	22,469 2.42%
1,000		0 0%	15,833 1.71%	434 0.05%
1,128*		0 0%	10,113 1.09%	368 0.04%

*Contract guaranteed MTBF.

⁺Indicates that the number is larger than that shown.

Table III-H
Percentage Impact on Fully-Equipped Rate

MTBF	Contractor Response	0%	100%	150%
500		6* 4.38%**	23 67.46%	12 7.84%
750		0 0%	11 13.44%	8 7.26%
1,000		0 0%	5 8.19%	3 0.37%
1,128***		0 0%	4 6.54%	2 0.48%

*Number of months non-support occurred.

**Percentage impact on fully-equipped rate for months with non-support.

***Contract guaranteed MTBF.

Interpretation of Simulation Results

One surprising result of the simulations was that the stockage position was maintained better when there was no contractor response than under either of the other two levels of contractor response. This condition resulted from two factors: more personnel were assigned in-house to support the INS under the no contractor response assumption; and the immediate commencement of in-house repair activity on D-Day, as opposed to waiting 91 days for training and receipt of equipment. The differences in personnel assignment resulted from the policy that was used to determine the assignments. The number of personnel that were assigned reflect an effort to balance the AGMC maintenance capability according to the priority of the workloads to be supported in the emergency.

That is, shortages in maintenance capability were to be rationed out inversely according to priority so as to not allow a disproportional shortage of maintenance capability to a single priority workload (27). Since equipment and data are optioned into the contract "to allow organic maintenance to come in anytime [7:2]," the assumption was made that organic maintenance activity would commence immediately if the contractor failed to continue support. These two factors more than make up for the interception of the learning curve at a higher point (312.5 actual hours for first time repair versus 208 actual hours for first time repair).

A peculiarity of the workload at AGMC also influenced the outcome of the simulations. A large part of the AGMC workload involves missile guidance systems that do not surge in the emergency scenario. Since the missile workloads do not surge, more personnel resources can be made available at AGMC than could be if the item were assigned to one of the other Technology Repair Centers (27). It should be pointed out, however, that the resources that can be made available at AGMC are finite and could not support a large influx of RIW items requiring additional maintenance support in the event of a surge.

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Conclusions

The effect of relying solely upon Delco, the INS contractor, for repair support until D-Day would present no major problem as long as the guaranteed MTBF of 1,128 hours is achieved and organic capability can be generated at the same rate that occurred in the simulations. Although contractor repair was insufficient to meet generated demands in all the simulations, shortages were incurred in only four months of the 100 percent contractor performance level simulation and two months in the 150 percent simulation due to the additional repair generated by organic maintenance facilities. The greatest impact on the fully-equipped rate for months in which shortages were incurred was the 6.54 percent experienced during the four months of the 100 percent contractor performance level simulation. This would roughly equate to a 93 percent operational ready rate if the INS were the only consideration; however, cannibalization of INS units from aircraft requiring major maintenance could be considered as an alternative to alleviate deficiencies in the area of INS shortages for aircraft that would otherwise be mission capable.

If the contractor fails to maintain the guaranteed MTBF of 1,128 hours for the INS, greater disruptions in mission support and extended periods of INS shortages can be expected unless organic repair capability beyond that generated in the simulations could be developed. Although data from an actual wartime surge could differ from data used in the simulations, the simulations should be representative since they were based upon information obtained from individuals and organizations that will be responsible for initiating organic repair for the INS in the event of a surge requirement in a national emergency.

Extreme disruptions occurred in one of the simulations (contractor performance at 100 percent and MTBF of 500 hours) when 83 percent of the support requirements could not be filled (this occurred in the 16th month). This situation appears to be highly unlikely, since the MTBF would be reduced below half the guaranteed MTBF. Undoubtedly, some adjustments in resource commitments would be made to alleviate these shortages, but the new allocations could have an adverse effect on the support of another item. The priorities of mission essential equipment would be a primary consideration for this reallocation of resources.

The results of the simulations with reduced MTBFs illustrate the importance of determining the impact that a commitment to allow a reliability improvement warranty to solely govern maintenance actions for a mission essential item could have on depot level maintenance support capability

in a wartime situation. This impact should be examined for each procurement action in which RIW clauses are proposed. AFR 800-21, which addresses Interim Contractor Support, requires such a study, and should be extended to include RIW contracts.

Recommendations for Future Research

Contractor response capability. The legal, economic, administrative, and physical considerations which could impinge on a contractor's capability to support surge requirements (heretofore cited) call for more extensive consideration when an item is selected for support on an RIW contract. In the literature review, no research was found that had as its subject an analysis of the expected contractor response to a surge requirement under an RIW contract. In view of the improved support posture that resulted in the simulations with an assumed contractor response of 150 percent over those obtained when the contractor response was 100 percent, an analysis of expected contractor response in the event of a surge should be considered a viable, necessary research topic with respect to RIW contracts.

Expected MTBF. Although a contractor guarantees the achievement of a certain average MTBF, there is no certainty that the contractor can or will achieve it. There could, for example, be a determination that the contractor would achieve a better profit position (smaller loss position) by accepting a contractual penalty when the achievement of the guaranteed

MTBF would cost more than would be lost through the penalty. The sensitivity of the simulations to changes in MTBF indicate that there should be a risk assessment of the expected MTBF. Research into the achievement of actual MTBFs versus guaranteed MTBFs would be beneficial in planning for the support of items in a surge.

RIW item support policy. As was alluded to in Chapter I, there is no uniform policy to determine whether in-house or contract support should be relied upon in the event of a national emergency. In the simulations completed in this study, in-house repair capability could satisfy the surge demands with no stock outage except in the instance where the achieved MTBF was 500. The simulations depend entirely on the estimates and assumptions that were made for their validity, however, and are thus restricted in their interpretation. Research comparing support sources (contractor vs. organic repair) in the event of surge conditions would be a valuable input to the policy formulation process.

APPENDIX A
DEVELOPMENT OF LEARNING CURVE
AND
STANFORD B FACTOR

APPENDIX A

DEVELOPMENT OF LEARNING CURVE AND STANFORD B FACTOR

The mathematical expression of the learning curve is $Y=K(X+SB)^n$ where Y is the time to repair the X^{th} item; K is the time required to repair the first item; X is the item number; SB is the Stanford B Factor; and n is log B divided by log 2 where B is the nominal value of the learning curve (90 percent equals .90). Three points on the learning curve which are required to compute the Stanford B Factor and the learning curve value are derived from Organic Repair Source Data given in Chapter II: the first item repair with no training requires 312.5 actual hours (125 standard hours divided by 40 percent labor efficiency); the first item repair with training requires 208 actual hours (125 standard hours divided by 60 percent labor efficiency); and the sixtieth item following training requires 138.88 actual hours (125 standard hours divided by 90 percent labor efficiency). These points allow two simultaneous equations to be developed:

$$Y=K(X+SB)^n$$

$$208=312.5(1+SB)^n$$

$$Y=K(X+SB)^n$$

$$138.88=312.5(60+SB)^n$$

The first equation establishes the relationship between the repair time of the first item following training and the

repair time of the first item with no training. The second equation establishes the relationship between the time required to repair the sixtieth item following training and the repair time of the first item with no training. The first step in the solution procedure is to solve the first equation in terms of n and to substitute that value of n in the second equation:

$$.6656 = (1+SB)^n$$

$$.444416 = (60+SB)^n$$

take the log of both equations:

$$-.176786 = (\log(1+SB))n$$

$$-.35221 = (\log(60+SB))n$$

$$n = \frac{-.176786}{\log(1+SB)}$$

substituting for n in the second equation:

$$-.35221 = (\log(60+SB)) \left(\frac{-.176786}{\log(1+SB)} \right)$$

$$1.9929(\log(1+SB)) - \log(60+SB) = 0$$

which is solved iteratively to yield: $SB = 7.3343$.

The Stanford B Factor is then substituted into the first equation to solve the learning curve value:

$$208 = 312.5(8.3343)^n$$

$$.6656 = (8.3343)^n$$

take the log of the equation:

$$-.176786 = .920869(n)$$

$$n = \frac{\log(\text{learning curve})}{\log 2} = -.191977$$

$$\log(\text{learning curve}) = (-.191977)(.301029) = -.057791$$

take the antilog:

$$\text{learning curve} = .8754.$$

APPENDIX B
PROGRAM VARIABLES AND CODING

APPENDIX B

PROGRAM VARIABLES AND CODING

Real Array Variables

DDRC(3,31) Poisson distribution of demands. Row one contains the value of the daily demand for repair (0 through 31); row two contains the individual probability of the demand value; and row three contains the cumulative probability of the demand value.

MD(24) Month's demands for two years.

MNCOMP(3,30,25) The second and third dimensions represent days and months respectively; thirty days to a month and twenty-four months (plus one to avoid data spillover in matrix manipulation). Row one contains the stock on hand at the beginning of the day; row two contains the day's demand based on a probabilistic poisson distribution of the average day's demand for the month; and row three contains the contractor's repair capability expressed in units with Saturdays and Sundays set to zero (in the third version, no contractor support, this entire field is set to zero).

NNCRED(2,5) Date of receipt and effect on repair time of noncritical equipment and data used in organic repair.

NORMAL(2,74) A discrete approximation of a normal (0,1) distribution. Row one contains the standard deviation value; row two contains the cumulative probability density of the associated standard deviation value in row one.

Real Scalar Variables

ADD Accumulates the cumulative probability density of the poisson distribution.

AVFAC	Percent of time available from organic workers that can be applied to direct effort, expressed in decimal equivalent.
A1	An artificial first item repair time used for learning curve computation when the Stanford factor is not equal to zero.
CR	Contract repair level expressed as the number of items repaired per day.
CRIW	Partially completed item in contract repair.
CRIWA	Completion of an item partially completed the previous day by the contractor.
CRL	Contract specified contractor repair capability in number of items per month.
FRT	Time to repair the first item by the organic facility as adjusted by the receipt of non-critical data and equipment.
K	Used in computing the factorial in the poisson distribution computation.
KFAC	Used in computing the factorial in the poisson distribution computation.
MD1	Average day's demand for the month.
PARTL	Number of hours required to complete a partially completed item in organic repair.
PCTDEV	Percentage of the <u>i</u> th item organic repair time that constitutes one standard deviation for the <u>i</u> th item repair time.
RNDM	A system supplied random number.
RTA	Organic repair time available.
SB	Stanford B factor used to adjust the learning curve to account for transfer of learning.
SOH1	Stock on hand on D-Day.
STDEV	One standard deviation of the current repair time.
SUN	Indicates Sunday if equal to 1.

TII	Time required to repair the first item by the organic facility.
X	A system supplied random number.
XLC	Log 10 of the learning curve value.
Y	The expected organic repair time for the <u>i</u> th item computed according to the learning curve.
YTRU	The computed organic repair time for the <u>i</u> th item based on a normal deviation about the expected repair time.

Integer Scalar Variables

CIR	Contract items repaired excluding completions of in work items carried over from a previous day.
I	Index for do loops 10 and 40.
ICREP	Number of items repaired by contract.
ICUMCR	Cumulative number of items repaired by contract.
ICUMDM	Cumulative number of demands.
ICUMOR	Cumulative number of items repaired organic.
IDDM	Day's demand.
II	Day of the week.
IMD1	Integer value day's demand.
IR	Number of items repaired by the organic facility.
ISOH	Stock on hand.
ITH	The number of the item in organic repair (first, second, etc.).
J	Index for do loops 30 and 50.
JJ	Index for do loops 25 and 90.
J3	Index for do loop 220.
J5	Index for do loop 175.

J6	Index for do loop 670.
KF	Used to compute factorial in poisson distribution computation.
MNPWR	Number of personnel available for organic repair.
N	Index for do loop 3.
NCRED	Date last critical equipment or data received.
NNCRE	Number of noncritical equipments and data.
NREP	Number of reparable.
SOH	Stock on hand at the end of the current day.

Coding

```

10*BRUN ** (ULIB,CORE=39K) GRADLIB/TSS, 4, LIBRARY/APPLIB, R;
20*FCNF, LIB/LIBRARY, R/AF, LIB/OLIBRARY, R
30 REAL NORMAL(2,74)
40 REAL NNCOMP(3,30,25), MD(24), MD1,K, KFAC, DDRC(3,31), CR
50 REAL CPM ,PARTL
60 REAL NNCRD(2,5)
70 INTEGER CTR ,DCR ,SON ,NREP ,ITH
80 DATA ((NORMAL(1,J),J=1,2),J=1,74)/.0001,-3.00,.0002,-3.41,.0003,
90 -3.48,.0005,-3.3,.0007,-3.2,.001,-3.1,.0013,-3...0019,-2.9,
100 -2.8,.0026,-2.8,.0039,-2.7,.0047,-2.6,.0062,-2.5,.0082,-2.4,.0107,
110 -2.3,.0139,-2.2,.0179,-2.1,.0028,-2...0287,-1.9,.0359,-1.8,
120 -1.7,.0540,-1.6,.0660,-1.5,.0800,-1.4,.0960,-1.3,.1151,
130 -1.2,.1357,-1.1,.1587,-1...1841,-.9,.2119,-.8,.2428,-.7,.2743,
140 -1.6,.3095,-.5,.3446,-.4,.3821,-.3,.4207,-.2,.4602,-.1,.5,0.0,
150 .6,5398,.1,.5793,.2,.6179,.3,.6554,.4,.6919,.5,.7257,.6,.7580,.7,
160 .7881,.8,.8199,.9,.8413,1...8643,1.1,.8849,1.2,.9032,1.3,.9192,
170 1.4,.9332,1.5,.9452,1.6,.9554,1.7,.9641,1.8,.9713,1.9,.9772,2..
180 .9821,2.1,.9861,2.2,.9893,2.3,.9918,2.4,.9938,2.5,.9953,2.6,
190 .9965,2.7,.9974,2.8,.9981,2.9,.9987,3...9990,3.1,.9993,3.2,.9995,
200 3.3,.9997,3.39,.9998,3.49,.9999,3.62,1..3.89/
210 DATA SON1/203./
220 DATA (MD(1),I=1,24)/250..250..250..229..229..229..226..
230 226..226..226..226..226..226..226..226..226..226..
240 226..226..226..226..226..226..226..226..226..226..
250 DATA CRL,T11,MNPMR,AVFAC/114..200..93..89/
260 DATA SD,NNCRD,NNCRF/7.3343,91.0/
270 DATA ((NNCRD(1,J),I=1,2),J=1,5)/1.0,0.0,2.0,0.0,
280 3.0,0.0,4.0,0.0,5.0,0.0/
290 DATA XLC,PCTDEV/.057791,20./
299C COMPUTATION OF 30 DAY'S DEMANDS FOR EACH MONTH
300 DO 10 I=1,24
310 MD1=MD(I)/30
320 IF(MD1.LE.13) GOTO 650
329C NORMAL APPROXIMATION OF POISSON DISTRIBUTION
330 DO 699 J=1,30
340 X=RNND(-1,0)
350 DO 470 J6=1,74
360 IF(X,LE.NORMAL(1,J6)) GOTO 680
370 470 CONTINUE
380 680 MD1=MD1+.5*((MD1+.5)*NORMAL(2,J6))
390 NNCOMP(2,J,1)=MD1
400 NNCOMP(3,J,1)=CRL/22
410 699 CONTINUE
420 800 690
430 650 ADD=0

439C POISSON DISTRIBUTION OF DEMANDS
440 DO 3 N=1,31
450 DDRC(1,N)=N-1
460 K=DDRC(1,N)
470 KF=K
480 IF(KF.LE.1)GOTO 7
490 KFAC=KF
500 5 KFAC=KFAC*(KF-1)

510 KF=KF-1

```

```

520 IF(KF-1.LE.1) GOTO 20
530 GOTO 5
540 7 KFAC=1
550 20 DDRC(2,N)=(MD1**K)*(2.71828**(-MD1))/KFAC
560 ADD=ADD+DDRC(2,N)
570 DDRC(3,N)=ADD
580 IF(DDRC(3,N).GT.0.99999) GOTO 17
590 3 CONTINUE
599C RANDOM SELECTION OF DAY'S DEMAND
600 13 DO 30 J=1,30
610 X=RND(-1.0)
620 DO 25 JJ=1,31
630 IF(X.LE.DDRC(3,JJ)) GOTO 17
640 25 CONTINUE
650 17 MNCOMP(2,J,1)=DDRC(1,JJ)
660 MNCOMP(3,J,1)=CRL/22
670 30 CONTINUE
680 690 X=0
690 10 CONTINUE
700 SON=SON1
709C COMPUTE 24 MONTHS
710 DO 50 J=1,24
720 PRINT 300,J
730 300 FORMAT(//,1X,"MONTH",2X,12)
740 PRINT 310;PRINT 350
750 310 FORMAT(1X,
760" REPAIRING" ITEMS REPAIRED ENDING IN")
770 350 FORMAT(1X,
780"DAY STOCK DEMAND REPARABLES CONTRACT ORGANIC STOCK WORK")
789C COMPUTE 30 DAYS FOR EACH MONTH
790 DO 40 I=1,30
799C DETERMINATION OF SATURDAY OR SUNDAY
800 11=11+1; IF(11.EQ.8)GOTO41
810 GOTO 42
820 41 11=1
830 42 SUN=0
840 IF(11.GE.4)GOTO 60
850 GOTO 80

```

```

860 60 IF(11.EQ.6) GOTO 70
870 SUN=1
880 70 MNCOMP(3,1,J)=0
890 80 MNCOMP(1,1,J)=SON
900 NREP=NREP+MNCOMP(2,1,J)
909C COMPUTATION OF CONTRACT REPAIR
910 CR=MNCOMP(3,1,J);CIR=0
920 CR1A=0
930 IF(CR1M .GT. CR ) GOTO 120
940 IF(CR1M .NE.0) GOTO 110
950 CR1A=0
960 GOTO 401
970 110 CR =CR -CR1M
980 CR1A=1
990 CR1M =0
1000 401 IF(CP .GT.NREP ) GOTO 140
1010 IF(NREP .LE.0)GOTO 150
1020 IF(CR .LE.1) GOTO 130
1030 CIR =CR
1040 CR1M =CR -CIR
1050 NREP =NREP -CR

```



```

1060 GOTO 150
1070 130 CRIM =1-CR
1080 NREP =NREP -1
1090 GOTO 150
1100 140 CIR =NREP
1110 NREP =0
1120 GOTO 150
1130 120 CRIM =CRIM -CR
1140 150 IR=0
1140C COMPUTATION OF ORGANIC REPAIR
1150 IF(SUM.EQ.1) GOTO 260
1160 IF(INCRED.GT.((1+((J-1)*30)))GOTO 260
1170 FRT=Y11
1180 DO 175 J3=1,NNCRE
1190 IF(NNCRED(1,J3).GT.(1+((J-1)*30)))GOTO 170
1200 FRT=FRT-(T11*NNCRED(2,J3))
1210 175 CONTINUE
1220 170 IF((NREP +PARTL ).LE.0)GOTO 260
1230 RTA=10.*MNPWR*AVFAC
1240 IF (PARTL .EQ.0) GOTO 195
1250 IF(PARTL .LE.RTA)GOTO 190
1260 PARTL =PARTL -RTA
1270 GOTO 260
1280 190 RTA=RTA-PARTL
1290 PARTL=0
1300 IR=1

1310 195 IF(NREP .EQ.0) GOTO 260
1320 NREP=NREP+1
1330 ITH =ITH +1
1340 IF(SR.NE.0)GOTO 200
1350 Y=FRT*((ITH **((XLC/.301029))) GOTO 210
1360 200 A1=FRT/((1+SR)**((XLC/.301029))
1370 Y=A1*((ITH +SR)**((XLC/.301029))
1380 210 RNDM=RND(-1.0)
1390 STDEV=Y*PCTDEV/100
1400 DO 220 J3=1,74
1410 IF(RNDM.LE.NORMAL(1,J3)) GOTO 230
1420 220 CONTINUE
1430 230 IF(RNDM.GT..0001) GOTO 231
1440 YTPU=Y*((.0001-RNDM)*(-100)-3.08)*STDEV
1450 GOTO 232
1460 231 YTRU=Y*((RNDM-NORMAL(1,(J3-1)))/(NORMAL(1,J3)-
1470 NORMAL(1,(J3-1)))+(NORMAL(2,J3)-NORMAL(2,(J3-1))
1480 +NORMAL(2,(J3-1)))*STDEV
1490 232 IF(YTRU.GE.0) GOTO 245
1500 YTRU=0
1510 245 IF(YTRU.GT.RTA) GOTO 240
1520 RTA=RTA-YTRU
1530 IR=IR+1
1540 GOTO 195
1550 240 PARTL =YTRU-RTA
1560 260 SUM=MNCOMP(1,I,J)-MNCOMP(2,I,J)+CIR+CRIMA+IR
1570 ISOM=MNCOMP(1,I,J)
1580 IDDM=MNCOMP(2,I,J)
1590 IF(PARTL.GT.0)GOTO 334
1600 INC=0; GOTO 335
1610 334 INC=1
1620 335 IF(CRIM.GT.0) GOTO 336
1630 INC=0; GOTO 337

1640 336 INC=1

```

1450 337 ICREP=CIR+CRWA

1660 297 PRINT 330,1,ISOH,IDDMD,NREP,ICREP,IR,SOH,(IHO+INC)

1670 330 FORMAT(1X,12,17,17,111,19,(8,16,15)

1680 ICUMOR=ICUMOR+IR

1690 ICUMCR=ICUMCR+ICREP

1700 ICUMDMR=ICUMDMR+IDDMD

1710 40 CONTINUE

1720 PRINT,"CUMULATIVE DEMAND=" ",ICUMDMR

1730 PRINT,"CUMULATIVE ORGANIC REPAIR=",ICUMOR

1740 PRINT,"CUMULATIVE CONTRACT RPAIR=",ICUMCR

1750 50 CONTINUE

1760 333 FORMAT (V)

1770 STOP

APPENDIX C
SIMULATION RESULTS

APPENDIX C

SIMULATION RESULTS

Introduction

The simulation results in this section were selected to illustrate trends for each of the twelve programs completed for this study. The programs are divided into twelve annexes to this appendix to separate the results by the contractor performance levels--100 percent, 150 percent, and 0 percent of contract specified levels--and the four MTBFs--contract specified MTBF plus three assumed MTBFs to examine the results in the event that the contractor fails to achieve the guaranteed MTBF. Each annex will be identified by contractor performance level (CPL) and the MTBF used for that simulation.

The first eight months of the simulations for 100 percent and 150 percent CPL and 1,128 Hours MTBF are given to coincide with information presented in Figures III-A and III-B. Only the first three months of the 0 percent CPL and 1,128 Hours MTBF simulation are needed to develop the trends shown in Table III-C, since the organic capability is sufficient to meet demands generated plus fill the stockage objectives. The remaining program results show the initial month, the month in which maximum stock-outs occur, and the

months when repair capability again covers generated demands
(or months giving the trend when repair will never meet total
demands).

ANNEX I

100 PERCENT CPL
1,128 HOURS MTBF

MONTH 1		ITEMS REPAIRED					ENDING IN	
BEGINNING								
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK	
1	283	10	4	5	0	278	1	
2	278	10	9	6	0	274	0	
3	274	8	11	5	0	271	1	
4	271	5	11	6	0	272	0	
5	272	11	16	5	0	266	1	
6	266	10	26	0	0	256	1	
7	256	7	33	0	0	249	1	
8	249	9	37	6	0	246	0	
9	246	3	34	5	0	248	1	
10	248	9	38	6	0	245	0	
11	245	3	35	5	0	247	1	
12	247	10	40	6	0	243	0	
13	243	7	46	0	0	236	1	
14	236	5	51	0	0	231	1	
15	231	10	56	5	0	226	1	
16	226	6	57	6	0	226	0	
17	226	7	58	5	0	224	1	
18	224	11	64	6	0	219	0	
19	219	12	70	5	0	212	1	
20	212	9	79	0	0	203	1	
21	203	11	90	0	0	192	1	
22	192	7	92	6	0	191	0	
23	191	8	94	5	0	188	1	
24	188	10	99	6	0	184	0	
25	184	8	101	5	0	181	1	
26	181	6	102	6	0	181	0	
27	181	10	111	0	0	171	1	
28	171	8	119	0	0	163	1	
29	163	9	123	5	0	159	1	
30	159	10	128	6	0	155	0	
CUMULATIVE DEMAND=					249			
CUMULATIVE ORGANIC REPAIR=					0			
CUMULATIVE CONTRACT RPAIR=					121			

MONTH 2		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	155	8	130	5	0	152	1
2	152	14	139	6	0	144	0
3	144	10	143	5	0	139	1
4	139	9	152	0	0	130	1
5	130	3	155	0	0	127	1
6	127	8	158	6	0	125	0
7	125	13	165	5	0	117	1
8	117	7	167	6	0	116	0
9	116	4	165	5	0	117	1
10	117	8	168	6	0	115	0
11	115	11	178	0	0	104	1
12	104	10	188	0	0	94	1
13	94	8	191	5	0	91	1
14	91	4	190	6	0	93	0
15	93	10	194	5	0	88	1
16	88	7	196	6	0	87	0
17	87	8	198	5	0	84	1
18	84	5	203	0	0	79	1
19	79	11	214	0	0	68	1
20	68	8	217	6	0	66	0
21	66	12	223	5	0	59	1
22	59	14	232	6	0	51	0
23	51	7	233	5	0	49	1
24	49	4	232	6	0	51	0
25	51	14	245	0	0	37	1
26	37	11	256	0	0	26	1
27	26	11	262	5	0	20	1
28	20	11	268	6	0	15	0
29	15	6	268	5	0	14	1
30	14	10	273	6	0	10	0
CUMULATIVE DEMAND=					515		
CUMULATIVE ORGANIC REPAIR=					0		
CUMULATIVE CONTRACT RPAIR=					242		

MONTH 3		BEGINNING		ITEMS REPAIRED		ENDING		IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK		
1	10	5	272	5	0	10	1		
2	10	11	283	0	0	-1	1		
3	-1	14	297	0	0	-15	1		
4	-15	5	297	6	0	-14	0		
5	-14	14	305	5	0	-23	1		
6	-23	9	309	6	0	-26	0		
7	-26	5	308	5	0	-26	1		
8	-26	11	314	6	0	-31	0		
9	-31	7	320	0	0	-38	1		
10	-38	13	333	0	0	-51	1		
11	-51	8	336	5	0	-54	1		
12	-54	12	343	6	0	-60	0		
13	-60	11	348	5	0	-66	1		
14	-66	7	350	6	0	-67	0		
15	-67	3	347	5	0	-65	1		
16	-65	12	359	0	0	-77	1		
17	-77	7	366	0	0	-84	1		
18	-84	14	375	6	0	-92	0		
19	-92	7	376	5	0	-94	1		
20	-94	4	375	6	0	-92	0		
21	-92	8	377	5	0	-95	1		
22	-95	8	380	6	0	-97	0		
23	-97	6	385	0	0	-103	1		
24	-103	12	397	0	0	-115	1		
25	-115	8	400	5	0	-118	1		
26	-118	11	406	6	0	-123	0		
27	-123	14	414	5	0	-132	1		
28	-132	9	418	6	0	-135	0		
29	-135	11	423	5	0	-141	1		
30	-141	12	435	0	0	-153	1		
CUMULATIVE DEMAND=					793				
CUMULATIVE ORGANIC REPAIR=					0				
CUMULATIVE CONTRACT RPAIR=					357				

MONTH 4		ITEMS REPAIRED				ENDING IN	
BEGINNING							
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	-153	4	439	0	0	-157	1
2	-157	3	433	6	3	-151	1
3	-151	9	432	5	4	-151	2
4	-151	12	435	6	4	-153	1
5	-153	8	434	5	3	-153	2
6	-153	11	436	6	4	-154	1
7	-154	10	440	0	5	-159	2
8	-159	6	446	0	0	-165	2
9	-165	9	446	5	4	-165	2
10	-165	6	443	6	4	-161	1
11	-161	5	436	5	6	-155	2
12	-155	8	434	6	5	-152	1
13	-152	8	431	5	5	-150	2
14	-150	4	430	0	5	-149	2
15	-149	6	436	0	0	-155	2
16	-155	8	433	6	6	-151	1
17	-151	7	429	5	5	-148	2
18	-148	5	423	6	6	-141	1
19	-141	6	418	5	5	-137	2
20	-137	6	412	6	7	-130	1
21	-130	6	411	0	6	-130	2
22	-130	9	420	0	0	-139	2
23	-139	7	416	5	6	-135	2
24	-135	11	416	6	6	-134	1
25	-134	8	412	5	6	-131	2
26	-131	8	409	6	6	-127	1
27	-127	7	405	5	5	-124	2
28	-124	7	405	0	7	-124	2
29	-124	4	409	0	0	-128	2
30	-128	5	403	6	6	-121	1
CUMULATIVE DEMAND=				1006			
CUMULATIVE ORGANIC REPAIR=				129			
CUMULATIVE CONTRACT RPAIR=				473			

MONTH 5		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	-121	5	395	5	7	-114	2
2	-114	4	389	6	5	-107	1
3	-107	11	387	5	7	-106	2
4	-106	7	384	6	5	-102	1
5	-102	5	381	0	7	-100	2
6	-100	9	390	0	0	-109	2
7	-109	14	392	5	7	-111	2
8	-111	7	388	6	6	-106	1
9	-106	9	384	5	7	-103	2
10	-103	12	385	6	6	-103	1
11	-103	5	378	5	6	-97	2
12	-97	8	379	0	7	-98	2
13	-98	2	381	0	0	-100	2
14	-100	6	376	6	6	-94	1
15	-94	7	370	5	7	-89	2
16	-89	9	368	6	6	-86	1
17	-86	7	362	5	7	-81	2
18	-81	12	363	6	6	-81	1
19	-81	5	361	0	6	-80	2
20	-80	10	371	0	0	-90	2
21	-90	6	365	5	7	-84	2
22	-84	7	360	6	7	-78	1
23	-78	6	353	5	7	-72	2
24	-72	11	351	6	8	-69	1
25	-69	7	345	5	7	-64	2
26	-64	10	348	0	7	-67	2
27	-67	8	356	0	0	-75	2
28	-75	6	350	6	7	-68	1
29	-68	9	346	5	7	-65	2
30	-65	6	339	6	8	-57	1

CUMULATIVE DEMAND=	1236
CUMULATIVE ORGANIC REPAIR=	302
CUMULATIVE CONTRACT RPAIR=	594

MONTH 6 BEGINNING		ITEMS REPAIRED			ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK WORK
1	-57	7	333	5	7	-52 2
2	-52	7	329	6	6	-47 1
3	-47	9	330	0	7	-49 2
4	-49	6	336	0	0	-55 2
5	-55	6	330	5	7	-49 2
6	-49	11	329	6	7	-47 1
7	-47	6	322	5	7	-41 2
8	-41	8	318	6	7	-36 1
9	-36	4	309	5	7	-28 2
10	-28	11	312	0	8	-31 2
11	-31	13	325	0	0	-44 2
12	-44	9	322	6	7	-40 1
13	-40	11	319	5	8	-38 2
14	-38	11	317	6	8	-35 1
15	-35	8	312	5	7	-31 2
16	-31	6	306	6	7	-24 1
17	-24	15	313	0	7	-32 2
18	-32	2	315	0	0	-34 2
19	-34	11	314	5	7	-33 2
20	-33	13	314	6	8	-32 1
21	-32	14	314	5	8	-33 2
22	-33	6	308	6	7	-26 1
23	-26	7	301	5	8	-20 2
24	-20	5	298	0	8	-17 2
25	-17	11	309	0	0	-28 2
26	-28	4	300	6	8	-18 1
27	-18	9	295	5	8	-14 2
28	-14	5	287	6	8	-5 1
29	-5	6	278	5	9	3 2
30	3	5	270	6	8	12 1
CUMULATIVE DEMAND=				1482		
CUMULATIVE ORGANIC REPAIR=				496		
CUMULATIVE CONTRACT RPAIR=				715		

MONTH	7	BEGINNING		ITEMS REPAIRED		ENDING		IN
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK	
1	12	7	269	0	7	12	2	
2	12	8	277	0	0	4	2	
3	4	11	274	5	9	7	2	
4	7	11	273	6	7	9	1	
5	9	8	267	5	8	14	2	
6	14	6	260	6	8	22	1	
7	22	6	253	5	7	28	2	
8	28	8	253	0	8	28	2	
9	28	3	256	0	0	25	2	
10	25	8	251	6	8	31	1	
11	31	16	253	5	8	28	2	
12	28	13	254	6	7	28	1	
13	28	14	253	5	9	28	2	
14	28	7	248	6	7	34	1	
15	34	7	245	0	9	36	2	
16	36	9	254	0	0	27	2	
17	27	4	246	5	7	35	2	
18	35	7	240	6	8	42	1	
19	42	7	234	5	7	47	2	
20	47	9	229	6	9	53	1	
21	53	6	220	5	9	61	2	
22	61	4	215	0	9	66	2	
23	66	6	221	0	0	60	2	
24	60	9	216	6	9	66	1	
25	66	10	211	5	9	70	2	
26	70	7	205	6	8	77	1	
27	77	8	197	5	10	84	2	
28	84	11	195	6	8	87	1	
29	87	3	189	0	8	92	2	
30	92	11	200	0	0	81	2	
CUMULATIVE DEMAND=				1726				
CUMULATIVE ORGANIC REPAIR=				699				
CUMULATIVE CONTRACT RPAIR=				825				

MONTH 8		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	81	7	193	5	9	88	2
2	88	7	186	6	9	96	1
3	96	7	179	5	8	102	2
4	102	8	174	6	8	108	1
5	108	8	168	5	8	113	2
6	113	7	166	0	9	115	2
7	115	9	175	0	0	106	2
8	106	6	166	6	10	116	1
9	116	8	160	5	8	121	2
10	121	11	157	6	9	125	1
11	125	6	147	5	10	134	2
12	134	8	142	6	8	140	1
13	140	5	137	0	9	144	2
14	144	7	144	0	0	137	2
15	137	10	141	5	8	140	2
16	140	6	134	6	8	148	1
17	148	7	127	5	8	154	2
18	154	12	124	6	10	158	1
19	158	2	111	5	9	170	2
20	170	5	108	0	8	173	2
21	173	10	118	0	0	163	2
22	163	7	111	6	9	171	1
23	171	11	107	5	9	174	2
24	174	6	100	6	8	182	1
25	182	6	91	5	9	190	2
26	190	3	80	6	9	202	1
27	202	8	77	0	10	204	2
28	204	6	83	0	0	198	2
29	198	8	77	5	9	204	2
30	204	5	68	6	9	214	1

CUMULATIVE DEMAND=

1942

CUMULATIVE ORGANIC REPAIR=

927

CUMULATIVE CONTRACT RPAIR=

946

ANNEX II

**150 PERCENT CPL
1,128 HOURS MTBF**

MONTH 1		ITEMS REPAIRED					ENDING IN	
BEGINNING								
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK	
1	283	8	0	7	0	282	1	
2	282	7	0	8	0	283	0	
3	283	10	2	7	0	280	1	
4	280	9	4	8	0	279	0	
5	279	5	1	7	0	281	1	
6	281	4	5	0	0	277	1	
7	277	6	11	0	0	271	1	
8	271	8	12	8	0	271	0	
9	271	11	15	7	0	267	1	
10	267	8	16	8	0	267	0	
11	267	6	14	7	0	268	1	
12	268	6	13	8	0	270	0	
13	270	11	23	0	0	259	1	
14	259	12	35	0	0	247	1	
15	247	8	36	7	0	246	1	
16	246	5	34	8	0	249	0	
17	249	5	31	7	0	251	1	
18	251	12	36	8	0	247	0	
19	247	15	43	7	0	239	1	
20	239	11	54	0	0	228	1	
21	228	14	68	0	0	214	1	
22	214	6	67	8	0	216	0	
23	216	8	67	7	0	215	1	
24	215	13	73	8	0	210	0	
25	210	11	76	7	0	206	1	
26	206	7	76	8	0	207	0	
27	207	8	83	0	0	199	1	
28	199	4	87	0	0	195	1	
29	195	10	90	7	0	192	1	
30	192	7	90	8	0	193	0	
CUMULATIVE DEMAND=					255			
CUMULATIVE ORGANIC REPAIR=					0			
CUMULATIVE CONTRACT RPAIR=					165			

MONTH 2		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	193	13	95	7	0	187	1
2	187	3	91	8	0	192	0
3	192	21	104	7	0	178	1
4	178	7	111	0	0	171	1
5	171	10	121	0	0	161	1
6	161	11	125	8	0	158	0
7	158	5	122	7	0	160	1
8	160	7	122	8	0	161	0
9	161	12	126	7	0	156	1
10	156	11	130	8	0	153	0
11	153	5	134	0	0	148	1
12	148	5	139	0	0	143	1
13	143	7	139	7	0	143	1
14	143	7	139	8	0	144	0
15	144	10	141	7	0	141	1
16	141	5	139	8	0	144	0
17	144	9	140	7	0	142	1
18	142	4	144	0	0	138	1
19	138	10	154	0	0	128	1
20	128	7	154	8	0	129	0
21	129	8	154	7	0	128	1
22	128	6	153	8	0	130	0
23	130	8	153	7	0	129	1
24	129	10	156	8	0	127	0
25	127	13	168	0	0	114	1
26	114	7	175	0	0	107	1
27	107	15	183	7	0	99	1
28	99	8	184	8	0	99	0
29	99	10	186	7	0	96	1
30	96	11	190	8	0	93	0
CUMULATIVE DEMAND=					520		
CUMULATIVE ORGANIC REPAIR=					0		
CUMULATIVE CONTRACT RPAIR=					330		

MONTH 3		BEGINNING		ITEMS REPAIRED		ENDING	IN
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	93	7	189	7	0	93	1
2	93	4	193	0	0	89	1
3	89	13	206	0	0	76	1
4	76	12	211	8	0	72	0
5	72	11	214	7	0	68	1
6	68	9	216	8	0	67	0
7	67	12	220	7	0	62	1
8	62	12	225	8	0	58	0
9	58	9	233	0	0	49	1
10	49	4	237	0	0	45	1
11	45	6	236	7	0	46	1
12	46	14	243	8	0	40	0
13	40	5	240	7	0	42	1
14	42	4	237	8	0	46	0
15	46	9	238	7	0	44	1
16	44	9	247	0	0	35	1
17	35	5	252	0	0	30	1
18	30	10	255	8	0	28	0
19	28	6	253	7	0	29	1
20	29	7	253	8	0	30	0
21	30	13	258	7	0	24	1
22	24	7	258	8	0	25	0
23	25	5	262	0	0	20	1
24	20	7	269	0	0	13	1
25	13	12	274	7	0	8	1
26	8	13	280	8	0	3	0
27	3	13	285	7	0	-3	1
28	-3	8	286	8	0	-3	0
29	-3	10	288	7	0	-6	1
30	-6	11	299	0	0	-17	1
CUMULATIVE DEMAND=					787		
CUMULATIVE ORGANIC REPAIR=					0		
CUMULATIVE CONTRACT RPAIR=					487		

MONTH 4		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	-17	9	308	0	0	-26	1
2	-26	10	308	8	2	-26	1
3	-26	14	311	7	3	-30	2
4	-30	7	308	8	3	-26	1
5	-26	2	299	7	3	-18	2
6	-18	11	300	8	3	-18	1
7	-18	7	303	0	3	-22	2
8	-22	6	309	0	0	-28	2
9	-28	2	302	7	2	-21	2
10	-21	5	296	8	4	-14	1
11	-14	2	287	7	3	-6	2
12	-6	9	287	8	2	-5	1
13	-5	11	286	7	4	-5	2
14	-5	3	286	0	3	-5	2
15	-5	9	295	0	0	-14	2
16	-14	9	294	8	3	-12	1
17	-12	7	290	7	3	-9	2
18	-9	5	284	8	4	-2	1
19	-2	8	281	7	3	0	2
20	0	11	282	8	3	0	1
21	0	9	287	0	3	-6	2
22	-6	5	292	0	0	-11	2
23	-11	11	292	7	4	-11	2
24	-11	13	294	8	4	-12	1
25	-12	6	289	7	3	-8	2
26	-8	4	282	8	4	0	1
27	0	5	276	7	3	5	2
28	5	7	278	0	5	3	2
29	3	7	285	0	0	-4	2
30	-4	8	282	8	4	0	1
CUMULATIVE DEMAND=					1009		
CUMULATIVE ORGANIC REPAIR=					81		
CUMULATIVE CONTRACT RPAIR=					645		

MONTH 5		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	0	9	279	7	4	2	2
2	2	6	274	8	4	8	1
3	8	5	268	7	3	13	2
4	13	5	262	8	4	20	1
5	20	11	267	0	5	14	2
6	14	6	273	0	0	8	2
7	8	4	267	7	3	14	2
8	14	9	265	8	4	17	1
9	17	8	262	7	3	19	2
10	19	10	260	8	5	22	1
11	22	8	256	7	4	25	2
12	25	12	265	0	3	16	2
13	16	6	271	0	0	10	2
14	10	2	261	8	5	21	1
15	21	9	258	7	4	23	2
16	23	6	252	8	5	30	1
17	30	7	248	7	3	33	2
18	33	7	244	8	4	38	1
19	38	7	246	0	4	35	2
20	35	7	253	0	0	28	2
21	28	11	253	7	4	28	2
22	28	4	245	8	5	37	1
23	37	9	242	7	4	39	2
24	39	7	238	8	4	44	1
25	44	6	231	7	5	50	2
26	50	8	235	0	4	46	2
27	46	5	240	0	0	41	2
28	41	9	238	8	4	44	1
29	44	5	230	7	5	51	2
30	51	6	225	8	4	57	1
CUMULATIVE DEMAND=					1223		
CUMULATIVE ORGANIC REPAIR=					187		
CUMULATIVE CONTRACT RPAIR=					810		

MONTH 6		BEGINNING		ITEMS REPAIRED		ENDING		IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK		
1	57	6	218	7	5	63	2		
2	63	7	214	8	4	68	1		
3	68	5	214	0	4	67	2		
4	67	9	223	0	0	58	2		
5	58	5	216	7	5	65	2		
6	65	9	214	8	4	68	1		
7	68	5	206	7	5	75	2		
8	75	9	204	8	4	78	1		
9	78	11	202	7	5	79	2		
10	79	7	204	0	5	77	2		
11	77	4	208	0	0	73	2		
12	73	10	207	8	4	75	1		
13	75	5	199	7	5	82	2		
14	82	15	203	8	4	79	1		
15	79	6	196	7	5	85	2		
16	85	9	194	8	4	88	1		
17	88	8	196	0	5	85	2		
18	85	2	198	0	0	83	2		
19	83	13	200	7	4	81	2		
20	81	9	197	8	5	85	1		
21	85	9	193	7	5	88	2		
22	88	10	192	8	4	90	1		
23	90	8	187	7	5	94	2		
24	94	7	190	0	4	91	2		
25	91	6	196	0	0	85	2		
26	85	5	189	8	5	93	1		
27	93	7	184	7	4	97	2		
28	97	4	176	8	5	106	1		
29	106	11	174	7	5	107	2		
30	107	8	170	8	5	112	1		
CUMULATIVE DEMAND=					1452				
CUMULATIVE ORGANIC REPAIR=					306				
CUMULATIVE CONTRACT RPAIR=					975				

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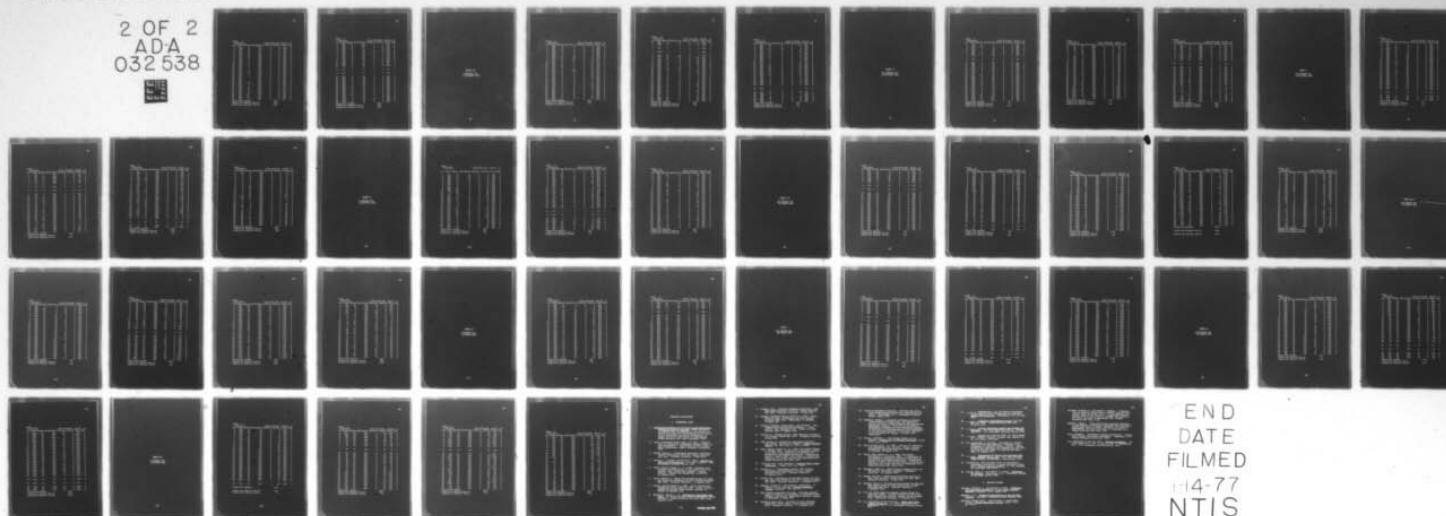
AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OHIO SCH0--ETC F/G 15/5
AN ANALYSIS OF USAF DEPOT LEVEL MAINTENANCE CAPABILITY TO MEET --ETC(U)
SEP 76 G W SHARP, J C TOSHACH

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MONTH 7		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	112	6	169	0	6	112	2
2	112	8	177	0	0	104	2
3	104	8	173	7	5	108	2
4	108	10	171	8	5	111	1
5	111	9	167	7	5	114	2
6	114	10	166	8	4	116	1
7	116	7	160	7	5	121	2
8	121	8	163	0	5	118	2
9	118	9	172	0	0	109	2
10	109	7	167	8	5	115	1
11	115	11	165	7	5	116	2
12	116	7	160	8	5	122	1
13	122	1	148	7	5	133	2
14	133	6	142	8	5	140	1
15	140	5	140	0	6	141	2
16	141	4	144	0	0	137	2
17	137	3	138	7	4	143	2
18	143	4	131	8	4	151	1
19	151		124	7	4	157	2
20	157	9	121	8	5	161	1
21	161	8	115	7	6	166	2
22	166	2	113	0	4	168	2
23	168	6	119	0	0	162	2
24	162	8	115	8	5	167	1
25	167	9	111	7	5	170	2
26	170	6	105	8	5	177	1
27	177	10	102	7	5	179	2
28	179	10	99	8	6	183	1
29	183	14	108	0	4	173	2
30	173	6	114	0	0	167	2
CUMULATIVE DEMAND=				1670			
CUMULATIVE ORGANIC REPAIR=				429			
CUMULATIVE CONTRACT RPAIR=				1125			

MONTH 8		ITEMS REPAIRED						ENDING IN	
DAY	BEGINNING STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK		
1	167	5	106	7	6	175	2		
2	175	6	100	8	5	182	1		
3	182	10	97	7	5	184	2		
4	184	6	91	8	5	191	1		
5	191	4	82	7	5	199	2		
6	199	9	86	0	5	195	2		
7	195	6	92	0	0	189	2		
8	189	8	88	8	5	194	1		
9	194	9	83	7	6	198	2		
10	198	7	77	8	6	205	1		
11	205	9	73	7	5	208	2		
12	208	5	66	8	5	216	1		
13	216	7	67	0	5	214	2		
14	214	7	74	0	0	207	2		
15	207	6	67	7	6	214	2		
16	214	8	63	8	5	219	1		
17	219	12	62	7	5	219	2		
18	219	8	58	8	5	224	1		
19	224	8	52	7	6	229	2		
20	229	3	51	0	4	230	2		
21	230	8	59	0	0	222	2		
22	222	14	61	8	5	221	1		
23	221	8	56	7	5	225	2		
24	225	3	47	8	5	235	1		
25	235	6	39	7	6	242	2		
26	242	10	36	8	6	246	1		
27	246	7	36	0	6	245	2		
28	245	7	43	0	0	238	2		
29	238	8	38	7	6	243	2		
30	243	5	31	8	5	251	1		
CUMULATIVE DEMAND=				1889					
CUMULATIVE ORGANIC REPAIR=				567					
CUMULATIVE CONTRACT RPAIR=				1290					

ANNEX III

0 PERCENT CPL
1,128 HOURS MTBF

MONTH 1	BEGINNING		ITEMS REPAIRED			ENDING	IN
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	283	8	1	0	6	281	1
2	281	8	0	0	9	282	1
3	282	12	4	0	8	278	1
4	278	4	0	0	9	283	0
5	283	8	0	0	8	283	0
6	283	6	0	0	6	283	0
7	283	12	12	0	0	271	0
8	271	13	15	0	9	267	1
9	267	9	11	0	13	271	1
10	271	7	7	0	11	275	1
11	275	10	6	0	11	276	1
12	276	12	7	0	11	275	1
13	275	9	4	0	12	278	1
14	278	9	13	0	0	269	1
15	269	10	10	0	13	272	1
16	272	9	7	0	12	275	1
17	275	9	3	0	13	279	1
18	279	6	0	0	10	283	0
19	283	9	0	0	9	283	0
20	283	8	0	0	8	283	0
21	283	8	8	0	0	275	0
22	275	8	3	0	12	279	1
23	279	9	0	0	13	283	0
24	283	6	0	0	6	283	0
25	283	5	0	0	5	283	0
26	283	7	0	0	7	283	0
27	283	4	0	0	4	283	0
28	283	8	8	0	0	275	0
29	275	4	0	0	12	283	0
30	283	5	0	0	5	283	0
CUMULATIVE DEMAND=					242		
CUMULATIVE ORGANIC REPAIR=					242		
CUMULATIVE CONTRACT RPAIR=					0		

MONTH 2		ITEMS REPAIRED					ENDING IN	
BEGINNING								
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK	
1	283	9	0	0	9	283	0	
2	283	14	0	0	13	282	1	
3	282	7	0	0	8	283	0	
4	283	6	0	0	6	283	0	
5	283	11	11	0	0	272	0	
6	272	14	12	0	12	270	1	
7	270	11	9	0	14	273	1	
8	273	5	0	0	14	282	1	
9	282	9	0	0	10	283	0	
10	283	11	0	0	11	283	0	
11	283	7	0	0	7	283	0	
12	283	13	13	0	0	270	0	
13	270	9	6	0	15	276	1	
14	276	7	0	0	14	283	0	
15	283	8	0	0	8	283	0	
16	283	4	0	0	4	283	0	
17	283	5	0	0	5	283	0	
18	283	8	0	0	8	283	0	
19	283	9	9	0	0	274	0	
20	274	17	10	0	15	272	1	
21	272	6	0	0	16	282	1	
22	282	11	0	0	12	283	0	
23	283	7	0	0	7	283	0	
24	283	12	0	0	12	283	0	
25	283	11	0	0	11	283	0	
26	283	6	6	0	0	277	0	
27	277	9	0	0	15	283	0	
28	283	11	0	0	11	283	0	
29	283	13	0	0	13	283	0	
30	283	13	0	0	13	283	0	
CUMULATIVE DEMAND=		525						
CUMULATIVE ORGANIC REPAIR=		525						
CUMULATIVE CONTRACT RPAIR=		0						

MONTH 3		BEGINNING			ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK	
1	283	13	0	0	13	283	0	
2	283	5	0	0	5	283	0	
3	283	10	10	0	0	273	0	
4	273	11	4	0	16	278	1	
5	278	4	0	0	9	283	0	
6	283	8	0	0	8	283	0	
7	283	10	0	0	10	283	0	
8	283	7	0	0	7	283	0	
9	283	9	0	0	9	283	0	
10	283	7	7	0	0	276	0	
11	276	4	0	0	11	283	0	
12	283	11	0	0	11	283	0	
13	283	12	0	0	12	283	0	
14	283	10	0	0	10	283	0	
15	283	15	0	0	15	283	0	
16	283	11	0	0	11	283	0	
17	283	10	10	0	0	273	0	
18	273	5	0	0	15	283	0	
19	283	7	0	0	7	283	0	
20	283	9	0	0	9	283	0	
21	283	14	0	0	14	283	0	
22	283	4	0	0	4	283	0	
23	283	9	0	0	9	283	0	
24	283	6	6	0	0	277	0	
25	277	10	0	0	16	283	0	
26	283	7	0	0	7	283	0	
27	283	9	0	0	9	283	0	
28	283	10	0	0	10	283	0	
29	283	5	0	0	5	283	0	
30	283	10	0	0	10	283	0	
CUMULATIVE DEMAND=					787			
CUMULATIVE ORGANIC REPAIR=					787			
CUMULATIVE CONTRACT RPAIR=					0			

ANNEX IV

**100 PERCENT CPL
1,000 HOURS MTBF**

MONTH	1							
BEGINNING								
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	REPAIRED ORGANIC	ENDING STOCK	IN WORK	
1	311	9	3	5	0	307	1	
2	307	11	9	6	0	302	0	
3	302	5	8	5	0	302	1	
4	302	7	10	6	0	301	0	
5	301	7	11	5	0	299	1	
6	299	4	15	0	0	295	1	
7	295	8	23	0	0	287	1	
8	287	4	22	6	0	289	0	
9	289	7	23	5	0	287	1	
10	287	6	24	6	0	287	0	
11	287	4	22	5	0	288	1	
12	288	8	25	6	0	286	0	
13	286	8	32	0	0	278	1	
14	278	7	39	0	0	271	1	
15	271	6	40	5	0	270	1	
16	270	16	51	6	0	260	0	
17	260	7	52	5	0	258	1	
18	258	11	58	6	0	253	0	
19	253	5	57	5	0	253	1	
20	253	6	63	0	0	247	1	
21	247	10	73	0	0	237	1	
22	237	6	74	6	0	237	0	
23	237	5	73	5	0	237	1	
24	237	8	76	6	0	235	0	
25	235	9	79	5	0	231	1	
26	231	9	83	6	0	228	0	
27	228	12	94	0	0	216	1	
28	216	11	105	0	0	205	1	
29	205	14	114	5	0	196	1	
30	196	9	118	6	0	193	0	
CUMULATIVE DEMAND=					239			
CUMULATIVE ORGANIC REPAIR=					0			
CUMULATIVE CONTRACT RPAIR=					121			

MONTH 3		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	27	10	288	5	0	22	1
2	22	7	295	0	0	15	1
3	15	12	307	0	0	3	1
4	3	11	313	6	0	-2	0
5	-2	12	319	5	0	-9	1
6	-9	7	321	6	0	-10	0
7	-10	7	322	5	0	-12	1
8	-12	10	327	6	0	-16	0
9	-16	6	332	0	0	-22	1
10	-22	14	346	0	0	-36	1
11	-36	9	350	5	0	-40	1
12	-40	13	358	6	0	-47	0
13	-47	9	361	5	0	-51	1
14	-51	9	365	6	0	-54	0
15	-54	11	370	5	0	-60	1
16	-60	11	381	0	0	-71	1
17	-71	10	391	0	0	-81	1
18	-81	6	392	6	0	-81	0
19	-81	5	391	5	0	-81	1
20	-81	6	392	6	0	-81	0
21	-81	17	403	5	0	-93	1
22	-93	10	408	6	0	-97	0
23	-97	7	414	0	0	-104	1
24	-104	10	424	0	0	-114	1
25	-114	11	430	5	0	-120	1
26	-120	16	441	6	0	-130	0
27	-130	9	444	5	0	-134	1
28	-134	13	452	6	0	-141	0
29	-141	7	453	5	0	-143	1
30	-143	7	460	0	0	-150	1
CUMULATIVE DEMAND=				818			
CUMULATIVE ORGANIC REPAIR=				0			
CUMULATIVE CONTRACT RPAIR=				357			

MONTH 7		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	-69	7	378	0	7	-69	2
2	-69	8	386	0	0	-77	2
3	-77	9	382	5	8	-73	2
4	-73	5	374	6	8	-64	1
5	-64	8	367	5	9	-58	2
6	-58	11	367	6	6	-57	1
7	-57	12	365	5	8	-56	2
8	-56	8	365	0	8	-56	2
9	-56	11	376	0	0	-67	2
10	-67	5	369	6	7	-59	1
11	-59	6	359	5	10	-50	2
12	-50	5	352	6	7	-42	1
13	-42	6	344	5	8	-35	2
14	-35	5	336	6	8	-26	1
15	-26	9	336	0	8	-27	2
16	-27	8	344	0	0	-35	2
17	-35	6	337	5	8	-28	2
18	-28	10	333	6	9	-23	1
19	-23	10	330	5	7	-21	2
20	-21	6	323	6	8	-13	1
21	-13	7	317	5	7	-8	2
22	-8	8	316	0	9	-7	2
23	-7	5	321	0	0	-12	2
24	-12	4	312	6	8	-2	1
25	-2	7	305	5	8	4	2
26	4	5	297	6	8	13	1
27	13	12	294	5	9	15	2
28	15	6	288	6	7	22	1
29	22	13	291	0	9	18	2
30	18	13	304	0	0	5	2
CUMULATIVE DEMAND=					1816		
CUMULATIVE ORGANIC REPAIR=					685		
CUMULATIVE CONTRACT RPAIR=					825		

ANNEX V

150 PERCENT CPL
1,000 HOURS MTBF

MONTH 1		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	311	6	0	6	0	311	0
2	311	8	0	8	0	311	0
3	311	14	5	8	0	305	1
4	305	8	5	9	0	306	0
5	306	10	6	8	0	304	1
6	304	12	18	0	0	292	1
7	292	6	24	0	0	286	1
8	286	13	29	9	0	282	0
9	282	8	28	8	0	282	1
10	282	9	29	9	0	282	0
11	282	10	30	8	0	280	1
12	280	15	37	9	0	274	0
13	274	9	45	0	0	265	1
14	265	9	54	0	0	256	1
15	256	4	50	8	0	260	1
16	260	10	52	9	0	259	0
17	259	8	51	8	0	259	1
18	259	10	53	9	0	258	0
19	258	7	51	8	0	259	1
20	259	9	60	0	0	250	1
21	250	11	71	0	0	239	1
22	239	9	72	9	0	239	0
23	239	2	65	8	0	245	1
24	245	9	66	9	0	245	0
25	245	14	71	8	0	239	1
26	239	6	69	9	0	242	0
27	242	4	72	0	0	238	1
28	238	6	78	0	0	232	1
29	232	10	80	8	0	230	1
30	230	11	83	9	0	228	0
CUMULATIVE DEMAND=					267		
CUMULATIVE ORGANIC REPAIR=					0		
CUMULATIVE CONTRACT RPAIR=					184		

MONTH 3		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	98	8	212	8	0	98	1
2	98	9	221	0	0	89	1
3	89	11	232	0	0	78	1
4	78	11	235	9	0	76	0
5	76	9	235	8	0	75	1
6	75	12	239	9	0	72	0
7	72	13	243	8	0	67	1
8	67	9	244	9	0	67	0
9	67	9	252	0	0	58	1
10	58	9	261	0	0	49	1
11	49	7	260	8	0	50	1
12	50	12	264	9	0	47	0
13	47	14	269	8	0	41	1
14	41	6	267	9	0	44	0
15	44	7	265	8	0	45	1
16	45	5	270	0	0	40	1
17	40	7	277	0	0	33	1
18	33	10	279	9	0	32	0
19	32	14	284	8	0	26	1
20	26	7	283	9	0	28	0
21	28	8	282	8	0	28	1
22	28	12	286	9	0	25	0
23	25	14	299	0	0	11	1
24	11	9	308	0	0	2	1
25	2	6	306	8	0	4	1
26	4	16	314	9	0	-3	0
27	-3	16	321	8	0	-11	1
28	-11	9	322	9	0	-11	0
29	-11	10	323	8	0	-13	1
30	-13	8	331	0	0	-21	1
CUMULATIVE DEMAND=					881		
CUMULATIVE ORGANIC REPAIR=					0		
CUMULATIVE CONTRACT REPAIR=					549		

MONTH	4			ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	-21	4	335	0	0	-25	1
2	-25	7	331	9	2	-21	1
3	-21	8	327	8	3	-18	2
4	-18	6	323	9	2	-13	1
5	-13	10	321	8	3	-12	2
6	-12	10	319	9	4	-9	1
7	-9	7	322	0	3	-13	2
8	-13	7	329	0	0	-20	2
9	-20	7	326	8	2	-17	2
10	-17	7	321	9	4	-11	1
11	-11	12	321	8	3	-12	2
12	-12	11	321	9	3	-11	1
13	-11	4	313	8	3	-4	2
14	-4	7	317	0	3	-8	2
15	-8	9	326	0	0	-17	2
16	-17	7	322	9	3	-12	1
17	-12	10	319	8	4	-10	2
18	-10	10	317	9	4	-7	1
19	-7	10	315	8	3	-6	2
20	-6	10	313	9	4	-3	1
21	-3	9	317	0	4	-8	2
22	-8	11	328	0	0	-19	2
23	-19	7	324	8	3	-15	2
24	-15	11	323	9	4	-13	1
25	-13	6	316	8	4	-7	2
26	-7	4	309	9	3	1	1
27	1	11	308	8	3	1	2
28	1	12	316	0	4	-7	2
29	-7	7	323	0	0	-14	2
30	-14	10	320	9	5	-10	1
CUMULATIVE DEMAND=					1132		
CUMULATIVE ORGANIC REPAIR=					83		
CUMULATIVE CONTRACT RPAIR=					728		

MONTH	5			ITEMS REPAIRED		ENDING	IN
BEGINNING				CONTRACT	ORGANIC	STOCK	WORK
DAY	STOCK	DEMAND	REPARABLES				
1	-10	5	312	8	4	-3	2
2	-3	4	305	9	3	5	1
3	5	12	304	8	4	5	2
4	5	8	299	9	5	11	1
5	11	6	301	0	3	8	2
6	8	9	310	0	0	-1	2
7	-1	9	306	8	5	3	2
8	3	14	308	9	4	2	1
9	2	16	310	8	5	-1	2
10	-1	10	308	9	4	2	1
11	2	9	305	8	3	4	2
12	4	11	311	0	5	-2	2
13	-2	10	321	0	0	-12	2
14	-12	11	320	9	4	-10	1
15	-10	6	313	8	4	-4	2
16	-4	7	308	9	4	2	1
17	2	6	302	8	3	7	2
18	7	8	298	9	4	12	1
19	12	6	299	0	4	10	2
20	10	4	303	0	0	6	2
21	6	9	299	8	5	10	2
22	10	6	293	9	4	17	1
23	17	11	291	8	4	18	2
24	18	9	288	9	4	22	1
25	22	9	284	8	4	25	2
26	25	11	291	0	4	18	2
27	18	5	296	0	0	13	2
28	13	5	289	9	4	21	1
29	21	8	284	8	4	25	2
30	25	8	279	9	5	31	1
CUMULATIVE DEMAND=				1384			
CUMULATIVE ORGANIC REPAIR=				189			
CUMULATIVE CONTRACT REPAIR=				915			

ANNEX VI

0 PERCENT CPL
1,000 HOURS MTBF

MONTH 1
BEGINNING

ITEMS REPAIRED ENDING IN

DAY STOCK DEMAND REPARABLES CONTRACT ORGANIC STOCK WORK

1	311	19	10	0	8	300	1
2	300	12	14	0	8	296	1
3	296	5	9	0	10	301	1
4	301	11	11	0	9	299	1
5	299	4	3	0	12	307	1
6	307	5	0	0	9	311	0
7	311	6	6	0	0	305	0
8	305	10	5	0	10	305	1
9	305	10	4	0	11	306	1
10	306	11	4	0	11	306	1
11	306	13	7	0	10	303	1
12	303	9	5	0	11	305	1
13	305	6	0	0	11	310	1
14	310	12	12	0	0	298	1
15	298	3	2	0	13	308	1
16	308	4	0	0	7	311	0
17	311	8	0	0	8	311	0
18	311	9	0	0	9	311	0
19	311	10	0	0	10	311	0
20	311	11	0	0	11	311	0
21	311	15	15	0	0	296	0
22	296	12	13	0	13	297	1
23	297	2	2	0	13	308	1
24	308	10	0	0	12	310	1
25	310	7	0	0	8	311	0
26	311	9	0	0	9	311	0
27	311	8	0	0	8	311	0
28	311	8	8	0	0	303	0
29	303	9	3	0	13	307	1
30	307	10	0	0	13	310	1

CUMULATIVE DEMAND=

268

CUMULATIVE ORGANIC REPAIR=

267

CUMULATIVE CONTRACT RPAIR=

0

MONTH 2		BEGINNING		ITEMS REPAIRED		ENDING		IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK		
1	310	9	0	0	10	311	0		
2	311	12	0	0	12	311	0		
3	311	15	0	0	14	310	1		
4	310	12	0	0	13	311	0		
5	311	13	13	0	0	298	0		
6	298	8	6	0	14	304	1		
7	304	11	2	0	15	308	1		
8	308	9	0	0	12	311	0		
9	311	7	0	0	7	311	0		
10	311	7	0	0	7	311	0		
11	311	12	0	0	12	311	0		
12	311	11	11	0	0	300	0		
13	300	13	9	0	14	301	1		
14	301	12	6	0	15	304	1		
15	304	11	1	0	16	309	1		
16	309	6	0	0	8	311	0		
17	311	10	0	0	10	311	0		
18	311	8	0	0	8	311	0		
19	311	7	7	0	0	304	0		
20	304	13	2	0	17	308	1		
21	308	10	0	0	13	311	0		
22	311	6	0	0	6	311	0		
23	311	10	0	0	10	311	0		
24	311	3	0	0	3	311	0		
25	311	6	0	0	6	311	0		
26	311	12	12	0	0	299	0		
27	299	16	11	0	16	299	1		
28	299	10	4	0	17	306	1		
29	306	13	1	0	16	309	1		
30	309	13	0	0	15	311	0		
CUMULATIVE DEMAND=					573				
CUMULATIVE ORGANIC REPAIR=					573				
CUMULATIVE CONTRACT RPAIR=					0				

MONTH 3		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	311	13	0	0	13	311	0
2	311	9	0	0	9	311	0
3	311	7	7	0	0	304	0
4	304	7	0	0	14	311	0
5	311	6	0	0	6	311	0
6	311	10	0	0	10	311	0
7	311	12	0	0	12	311	0
8	311	5	0	0	5	311	0
9	311	6	0	0	6	311	0
10	311	12	12	0	0	299	0
11	299	8	3	0	16	307	1
12	307	16	3	0	16	307	1
13	307	7	0	0	11	311	0
14	311	7	0	0	7	311	0
15	311	12	0	0	12	311	0
16	311	15	0	0	15	311	0
17	311	6	6	0	0	305	0
18	305	9	0	0	15	311	0
19	311	6	0	0	6	311	0
20	311	7	0	0	7	311	0
21	311	11	0	0	11	311	0
22	311	6	0	0	6	311	0
23	311	8	0	0	8	311	0
24	311	10	10	0	0	301	0
25	301	16	7	0	18	303	1
26	303	6	0	0	14	311	0
27	311	5	0	0	5	311	0
28	311	8	0	0	8	311	6
29	311	10	0	0	10	311	0
30	311	8	0	0	8	311	0
CUMULATIVE DEMAND=					841		
CUMULATIVE ORGANIC REPAIR=					841		
CUMULATIVE CONTRACT RPAIR=					0		

ANNEX VII

100 PERCENT CPL
750 HOURS MTBF

MONTH 1		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	391	11	3	7	0	387	1
2	387	12	8	8	0	383	0
3	383	17	17	7	0	373	1
4	373	16	26	8	0	365	0
5	365	14	32	7	0	358	1
6	358	8	40	0	0	350	1
7	350	9	49	0	0	341	1
8	341	11	53	8	0	338	0
9	338	8	53	7	0	337	1
10	337	13	59	8	0	332	0
11	332	16	67	7	0	323	1
12	323	12	72	8	0	319	0
13	319	14	85	0	0	305	1
14	305	15	100	0	0	290	1
15	290	10	103	7	0	287	1
16	287	11	107	8	0	284	0
17	284	14	113	7	0	277	1
18	277	16	122	8	0	269	0
19	269	14	128	7	0	262	1
20	262	8	136	0	0	254	1
21	254	12	148	0	0	242	1
22	242	13	154	8	0	237	0
23	237	14	160	7	0	230	1
24	230	17	170	8	0	221	0
25	221	12	174	7	0	216	1
26	216	13	180	8	0	211	0
27	211	12	191	0	0	199	1
28	199	12	203	0	0	187	1
29	187	8	204	7	0	186	1
30	186	16	213	8	0	178	0
CUMULATIVE DEMAND=					378		
CUMULATIVE ORGANIC REPAIR=					0		
CUMULATIVE CONTRACT RPAIR=					165		

MONTH 2		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	178	13	218	7	0	172	1
2	172	11	222	8	0	169	0
3	169	10	224	7	0	166	1
4	166	6	230	0	0	160	1
5	160	20	250	0	0	140	1
6	140	10	253	8	0	138	0
7	138	18	263	7	0	127	1
8	127	12	268	8	0	123	0
9	123	15	275	7	0	115	1
10	115	15	283	8	0	108	0
11	108	18	300	0	0	90	1
12	90	18	318	0	0	72	1
13	72	12	323	7	0	67	1
14	67	14	330	8	0	61	0
15	61	13	335	7	0	55	1
16	55	10	338	8	0	53	0
17	53	11	341	7	0	49	1
18	49	10	351	0	0	39	1
19	39	6	357	0	0	33	1
20	33	8	358	8	0	33	0
21	33	13	363	7	0	27	1
22	27	12	368	8	0	23	0
23	23	8	368	7	0	22	1
24	22	11	372	8	0	19	0
25	19	17	388	0	0	2	1
26	2	11	399	0	0	-9	1
27	-9	6	398	7	0	-8	1
28	-8	10	401	8	0	-10	0
29	-10	18	411	7	0	-21	1
30	-21	11	415	8	0	-24	0
CUMULATIVE DEMAND=					745		
CUMULATIVE ORGANIC REPAIR=					0		
CUMULATIVE CONTRACT RPAIR=					330		

MONTH 3		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	-24	17	424	7	0	-34	1
2	-34	16	440	0	0	-50	1
3	-50	11	451	0	0	-61	1
4	-61	10	462	8	0	-71	0
5	-71	13	467	7	0	-77	1
6	-77	13	473	8	0	-82	0
7	-82	9	474	7	0	-84	1
8	-84	9	476	8	0	-85	0
9	-85	13	488	0	0	-98	1
10	-98	16	504	0	0	-114	1
11	-114	15	512	7	0	-122	1
12	-122	15	520	8	0	-129	0
13	-129	10	522	7	0	-132	1
14	-132	10	525	8	0	-134	0
15	-134	11	528	7	0	-138	1
16	-138	13	541	0	0	-151	1
17	-151	11	552	0	0	-162	1
18	-162	10	555	8	0	-164	0
19	-164	9	556	7	0	-166	1
20	-166	10	559	8	0	-168	0
21	-168	10	561	7	0	-171	1
22	-171	11	565	8	0	-174	0
23	-174	12	576	0	0	-186	1
24	-186	9	585	0	0	-195	1
25	-195	8	586	7	0	-196	1
26	-196	8	587	8	0	-196	0
27	-196	13	592	7	0	-202	1
28	-202	13	598	8	0	-207	0
29	-207	16	606	7	0	-216	1
30	-216	12	618	0	0	-228	1
CUMULATIVE DEMAND=				1106			
CUMULATIVE ORGANIC REPAIR=				0			
CUMULATIVE CONTRACT RPAIR=				487			

MONTH 11 BEGINNING		ITEMS REPAIRED		ENDING IN			
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	-143	10	542	0	0	-153	2
2	-153	12	538	8	9	-148	1
3	-148	14	534	7	10	-145	2
4	-145	16	534	8	9	-144	1
5	-144	10	527	7	9	-138	2
6	-138	15	526	8	9	-136	1
7	-136	8	523	0	10	-134	2
8	-134	10	533	0	0	-144	2
9	-144	9	525	7	10	-136	2
10	-136	12	521	8	9	-131	1
11	-131	16	520	7	9	-131	2
12	-131	7	509	8	11	-119	1
13	-119	8	500	7	9	-111	2
14	-111	10	501	0	9	-112	2
15	-112	12	513	0	0	-124	2
16	-124	9	506	8	9	-116	1
17	-116	10	497	7	11	-108	2
18	-108	15	495	8	10	-105	1
19	-105	13	491	7	9	-102	2
20	-102	10	486	8	8	-96	1
21	-96	11	486	0	10	-97	2
22	-97	13	499	0	0	-110	2
23	-110	12	494	7	10	-105	2
24	-105	7	484	8	10	-94	1
25	-94	4	470	7	10	-81	2
26	-81	9	462	8	10	-72	1
27	-72	12	456	7	10	-67	2
28	-67	9	454	0	11	-65	2
29	-65	13	467	0	0	-78	2
30	-78	10	460	8	10	-70	1
CUMULATIVE DEMAND=				3876			
CUMULATIVE ORGANIC REPAIR=				1645			
CUMULATIVE CONTRACT RPAIR=				1770			

MONTH 12		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	-70	12	454	7	10	-65	2
2	-65	7	444	8	10	-54	1
3	-54	16	442	7	10	-53	2
4	-53	9	434	8	10	-44	1
5	-44	8	432	0	9	-43	2
6	-43	16	448	0	0	-59	2
7	-59	17	448	7	10	-59	2
8	-59	10	441	8	10	-51	1
9	-51	15	438	7	10	-49	2
10	-49	15	436	8	10	-46	1
11	-46	8	425	7	11	-36	2
12	-36	6	421	0	10	-32	2
13	-32	4	425	0	0	-36	2
14	-36	9	417	8	10	-27	1
15	-27	9	409	7	9	-20	2
16	-20	6	398	8	10	-8	1
17	-8	15	395	7	10	-4	2
18	-6	12	389	8	11	1	1
19	1	9	388	0	9	1	2
20	1	12	400	0	0	-11	2
21	-11	14	397	7	10	-8	2
22	-8	14	394	8	10	-4	1
23	-4	16	392	7	10	-3	2
24	-3	10	385	8	10	5	1
25	5	7	374	7	10	15	2
26	15	11	375	0	10	14	2
27	14	17	392	0	0	-3	2
28	-3	3	378	8	10	12	1
29	12	6	367	7	9	22	2
30	22	10	359	8	11	31	1
CUMULATIVE DEMAND=				4199			
CUMULATIVE ORGANIC REPAIR=				1904			
CUMULATIVE CONTRACT RPAIR=				1935			

ANNEX VIII

150 PERCENT CPL
750 HOURS MTBF

MONTH 1		ITEMS REPAIRED				ENDING IN	
BEGINNING							
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	391	9	0	9	0	391	0
2	391	12	0	11	0	390	1
3	390	13	2	12	0	389	0
4	389	14	4	11	0	386	1
5	386	12	5	12	0	386	0
6	386	15	19	0	0	371	1
7	371	15	34	0	0	356	1
8	356	17	40	11	0	350	1
9	350	15	44	12	0	347	0
10	347	15	47	11	0	343	1
11	343	12	48	12	0	343	0
12	343	16	52	11	0	338	1
13	338	15	67	0	0	323	1
14	323	19	86	0	0	304	1
15	304	11	86	12	0	305	0
16	305	14	88	11	0	302	1
17	302	19	96	12	0	295	0
18	295	14	98	11	0	292	1
19	292	12	99	12	0	292	0
20	292	10	108	0	0	282	1
21	282	12	120	0	0	270	1
22	270	5	114	11	0	276	1
23	276	13	116	12	0	275	0
24	275	12	116	11	0	274	1
25	274	13	118	12	0	273	0
26	273	12	118	11	0	272	1
27	272	10	128	0	0	262	1
28	262	7	135	0	0	255	1
29	255	15	139	12	0	252	0
30	252	10	137	11	0	253	1
CUMULATIVE DEMAND=					388		
CUMULATIVE ORGANIC REPAIR=					0		
CUMULATIVE CONTRACT RPAIR=					250		

MONTH 3		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	65	14	328	12	0	63	0
2	63	14	341	0	0	49	1
3	49	16	357	0	0	33	1
4	33	11	357	11	0	33	1
5	33	15	361	12	0	30	0
6	30	9	358	11	0	32	1
7	32	9	356	12	0	35	0
8	35	16	360	11	0	30	1
9	30	9	369	0	0	21	1
10	21	17	386	0	0	4	1
11	4	22	397	12	0	-6	0
12	-6	10	395	11	0	-5	1
13	-5	20	404	12	0	-13	0
14	-13	15	407	11	0	-17	1
15	-17	8	404	12	0	-13	0
16	-13	15	418	0	0	-28	1
17	-28	12	430	0	0	-40	1
18	-40	12	431	11	0	-41	1
19	-41	11	431	12	0	-40	0
20	-40	17	436	11	0	-46	1
21	-46	16	441	12	0	-50	0
22	-50	18	447	11	0	-57	1
23	-57	13	460	0	0	-70	1
24	-70	23	483	0	0	-93	1
25	-93	16	488	12	0	-97	0
26	-97	13	489	11	0	-99	1
27	-99	12	490	12	0	-99	0
28	-99	13	491	11	0	-101	1
29	-101	20	500	12	0	-109	0
30	-109	5	504	0	0	-114	1
CUMULATIVE DEMAND=					1250		
CUMULATIVE ORGANIC REPAIR=					0		
CUMULATIVE CONTRACT RPAIR=					745		

MONTH 5		BEGINNING		ITEMS REPAIRED		ENDING		IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK		
1	-160	13	547	12	4	-157	1		
2	-157	16	547	11	4	-158	2		
3	-158	14	547	12	3	-157	1		
4	-157	14	545	11	4	-156	2		
5	-156	7	548	0	4	-159	2		
6	-159	10	558	0	0	-169	2		
7	-169	4	547	12	4	-157	1		
8	-157	10	541	11	4	-152	2		
9	-152	14	540	12	4	-150	1		
10	-150	14	537	11	5	-148	2		
11	-148	11	533	12	4	-143	1		
12	-143	12	540	0	4	-151	2		
13	-151	15	555	0	0	-166	2		
14	-166	28	568	11	4	-179	2		
15	-179	10	562	12	5	-172	1		
16	-172	9	555	11	4	-166	2		
17	-166	7	547	12	4	-157	1		
18	-157	16	546	11	5	-157	2		
19	-157	17	559	0	4	-170	2		
20	-170	12	571	0	0	-182	2		
21	-182	11	567	12	4	-177	1		
22	-177	7	558	11	4	-169	2		
23	-169	9	551	12	5	-161	1		
24	-161	17	551	11	5	-162	2		
25	-162	11	547	12	4	-157	1		
26	-157	14	556	0	4	-167	2		
27	-167	11	567	0	0	-178	2		
28	-178	11	563	11	4	-174	2		
29	-174	21	568	12	5	-178	1		
30	-178	13	565	11	4	-176	2		
CUMULATIVE DEMAND=				1997					
CUMULATIVE ORGANIC REPAIR=				191					
CUMULATIVE CONTRACT RPAIR=				1239					

MONTH 10 BEGINNING		ITEMS REPAIRED		ENDING IN			
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	-25	13	410	12	6	-20	1
2	-20	13	416	0	6	-27	2
3	-27	9	425	0	0	-36	2
4	-36	7	415	11	6	-26	2
5	-26	8	407	12	5	-17	1
6	-17	9	398	11	6	-9	2
7	-9	10	391	12	6	-1	1
8	-1	9	383	11	5	6	2
9	6	9	386	0	6	3	2
10	3	11	397	0	0	-8	2
11	-8	10	391	12	5	-1	1
12	-1	12	385	11	6	4	2
13	4	7	376	12	5	14	1
14	14	11	369	11	6	20	2
15	20	16	368	12	6	22	1
16	22	10	371	0	6	18	2
17	18	15	386	0	0	3	2
18	3	8	377	11	6	12	2
19	12	16	377	12	5	13	1
20	13	5	365	11	5	24	2
21	24	12	360	12	6	30	1
22	30	9	351	11	6	38	2
23	38	11	356	0	6	33	2
24	33	16	372	0	0	17	2
25	17	12	367	12	6	23	1
26	23	7	356	11	6	33	2
27	33	9	348	12	6	42	1
28	42	16	346	11	6	43	2
29	43	15	344	12	6	46	1
30	46	9	346	0	6	43	2
CUMULATIVE DEMAND=				3690			
CUMULATIVE ORGANIC REPAIR=				872			
CUMULATIVE CONTRACT RPAIR=				2470			

ANNEX IX

0 PERCENT CPL
750 HOURS MTBF

MONTH 1	BEGINNING		ITEMS REPAIRED			ENDING	IN
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	391	11	3	0	7	387	1
2	387	13	7	0	9	383	1
3	383	8	7	0	8	383	1
4	383	18	15	0	10	375	1
5	375	22	27	0	10	363	1
6	363	12	27	0	12	363	1
7	363	15	42	0	0	348	1
8	348	16	47	0	11	343	1
9	343	13	50	0	10	340	1
10	340	13	53	0	10	337	1
11	337	8	49	0	12	341	1
12	341	12	49	0	12	341	1
13	341	18	56	0	11	334	1
14	334	8	64	0	0	326	1
15	326	12	64	0	12	326	1
16	326	14	64	0	14	326	1
17	326	16	68	0	12	322	1
18	322	9	65	0	12	325	1
19	325	11	63	0	13	327	1
20	327	19	69	0	13	321	1
21	321	13	82	0	0	308	1
22	308	19	86	0	15	304	1
23	304	11	83	0	14	307	1
24	307	12	82	0	13	308	1
25	308	17	85	0	14	305	1
26	305	15	85	0	15	305	1
27	305	7	79	0	13	311	1
28	311	12	91	0	0	299	1
29	299	16	92	0	15	298	1
30	298	15	94	0	13	296	1
CUMULATIVE DEMAND=					405		
CUMULATIVE ORGANIC REPAIR=					310		
CUMULATIVE CONTRACT RPAIR=					0		

MONTH 2		BEGINNING		ITEMS REPAIRED		ENDING	IN
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	296	13	93	0	14	297	1
2	297	16	94	0	15	296	1
3	296	11	91	0	14	299	1
4	299	17	93	0	15	297	1
5	297	9	102	0	0	288	1
6	288	16	104	0	14	286	1
7	286	11	99	0	16	291	1
8	291	18	101	0	16	289	1
9	289	18	104	0	15	286	1
10	286	15	103	0	16	287	1
11	287	9	98	0	14	292	1
12	292	13	111	0	0	279	1
13	279	15	110	0	16	280	1
14	280	13	109	0	14	281	1
15	281	20	113	0	16	277	1
16	277	11	109	0	15	281	1
17	281	10	102	0	17	288	1
18	288	14	100	0	16	290	1
19	290	17	117	0	0	273	1
20	273	15	117	0	15	273	1
21	273	9	111	0	15	279	1
22	279	20	115	0	16	275	1
23	275	10	108	0	17	282	1
24	282	12	104	0	16	286	1
25	286	13	100	0	17	290	1
26	290	10	110	0	0	280	1
27	280	20	113	0	17	277	1
28	277	15	110	0	18	280	1
29	280	18	112	0	16	278	1
30	278	15	111	0	16	279	1
CUMULATIVE DEMAND=				828			
CUMULATIVE ORGANIC REPAIR=				716			
CUMULATIVE CONTRACT RPAIR=				0			

ANNEX X

**100 PERCENT CPL
500 HOURS MTBF**

MONTH 1		BEGINNING		ITEMS REPAIRED		ENDING		IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK		
1	545	25	13	11	0	531	1		
2	531	23	25	12	0	520	0		
3	520	26	39	11	0	505	1		
4	505	22	50	12	0	495	0		
5	495	17	55	11	0	489	1		
6	489	15	70	0	0	474	1		
7	474	18	88	0	0	456	1		
8	456	20	97	12	0	448	0		
9	448	18	103	11	0	441	1		
10	441	21	113	12	0	432	0		
11	432	18	119	11	0	425	1		
12	425	26	134	12	0	411	0		
13	411	17	150	0	0	394	1		
14	394	19	169	0	0	375	1		
15	375	19	177	11	0	367	1		
16	367	24	190	12	0	355	0		
17	355	17	195	11	0	349	1		
18	349	23	207	12	0	338	0		
19	338	8	203	11	0	341	1		
20	341	22	225	0	0	319	1		
21	319	22	247	0	0	297	1		
22	297	22	258	12	0	287	0		
23	287	19	265	11	0	279	1		
24	279	26	280	12	0	265	0		
25	265	22	290	11	0	254	1		
26	254	15	294	12	0	251	0		
27	251	17	310	0	0	234	1		
28	234	19	329	0	0	215	1		
29	215	14	332	11	0	212	1		
30	212	20	341	12	0	204	0		
CUMULATIVE DEMAND=					594				
CUMULATIVE ORGANIC REPAIR=					0				
CUMULATIVE CONTRACT RPAIR=					253				

MONTH 2		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	204	21	350	11	0	194	1
2	194	20	359	12	0	186	0
3	186	19	366	11	0	178	1
4	178	19	385	0	0	159	1
5	159	21	406	0	0	138	1
6	138	17	412	12	0	133	0
7	133	17	417	11	0	127	1
8	127	26	432	12	0	113	0
9	113	23	443	11	0	101	1
10	101	19	451	12	0	94	0
11	94	26	476	0	0	68	1
12	68	26	502	0	0	42	1
13	42	21	512	11	0	32	1
14	32	15	516	12	0	29	0
15	29	20	524	11	0	20	1
16	20	16	529	12	0	16	0
17	16	17	534	11	0	10	1
18	10	20	554	0	0	-10	1
19	-10	22	576	0	0	-32	1
20	-32	16	581	12	0	-36	0
21	-36	19	588	11	0	-44	1
22	-44	18	595	12	0	-50	0
23	-50	20	603	11	0	-59	1
24	-59	18	610	12	0	-65	0
25	-65	18	627	0	0	-83	1
26	-83	11	638	0	0	-94	1
27	-94	15	642	11	0	-98	1
28	-98	30	661	12	0	-116	0
29	-116	28	677	11	0	-133	1
30	-133	18	684	12	0	-139	0
CUMULATIVE DEMAND=					1190		
CUMULATIVE ORGANIC REPAIR=					0		
CUMULATIVE CONTRACT RPAIR=					506		

MONTH 3		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	-139	15	687	11	0	-143	1
2	-143	13	700	0	0	-156	1
3	-156	21	721	0	0	-177	1
4	-177	21	731	12	0	-186	0
5	-186	22	741	11	0	-197	1
6	-197	20	750	12	0	-205	0
7	-205	20	758	11	0	-214	1
8	-214	18	765	12	0	-220	0
9	-220	19	783	0	0	-239	1
10	-239	22	805	0	0	-261	1
11	-261	22	816	11	0	-272	1
12	-272	14	819	12	0	-274	0
13	-274	19	826	11	0	-282	1
14	-282	21	836	12	0	-291	0
15	-291	14	838	11	0	-294	1
16	-294	23	861	0	0	-317	1
17	-317	16	877	0	0	-333	1
18	-333	23	889	12	0	-344	0
19	-344	15	892	11	0	-348	1
20	-348	10	891	12	0	-346	0
21	-346	14	893	11	0	-349	1
22	-349	25	907	12	0	-362	0
23	-362	19	925	0	0	-381	1
24	-381	17	942	0	0	-398	1
25	-398	22	953	11	0	-409	1
26	-409	28	970	12	0	-425	0
27	-425	20	978	11	0	-434	1
28	-434	22	989	12	0	-444	0
29	-444	11	988	11	0	-444	1
30	-444	29	1017	0	0	-473	1
CUMULATIVE DEMAND=					1765		
CUMULATIVE ORGANIC REPAIR=					0		
CUMULATIVE CONTRACT RPAIR=					747		

ANNEX XI

150 PERCENT CPL
500 HOURS MTBF

MONTH 1	BEGINNING		ITEMS REPAIRED			ENDING	IN
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	545	19	1	17	0	543	1
2	543	15	0	17	0	545	0
3	545	16	0	16	0	545	0
4	545	18	0	17	0	544	1
5	544	19	2	18	0	543	0
6	543	19	20	0	0	524	1
7	524	22	42	0	0	502	1
8	502	17	42	17	0	502	1
9	502	19	44	18	0	501	0
10	501	16	42	17	0	502	1
11	502	16	41	18	0	504	0
12	504	17	40	17	0	504	1
13	504	21	61	0	0	483	1
14	483	14	75	0	0	469	1
15	469	25	83	18	0	462	0
16	462	19	84	17	0	460	1
17	460	25	92	18	0	453	0
18	453	18	92	17	0	452	1
19	452	18	93	18	0	452	0
20	452	16	108	0	0	436	1
21	436	11	119	0	0	425	1
22	425	30	132	17	0	412	1
23	412	22	137	18	0	408	0
24	408	28	147	17	0	397	1
25	397	21	151	18	0	394	0
26	394	18	151	17	0	393	1
27	393	23	174	0	0	370	1
28	370	19	193	0	0	351	1
29	351	21	197	18	0	348	0
30	348	19	198	17	0	346	1
CUMULATIVE DEMAND=					581		
CUMULATIVE ORGANIC REPAIR=					0		
CUMULATIVE CONTRACT RPAIR=					382		

MONTH 3		BEGINNING		ITEMS REPAIRED		ENDING		IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK		
1	157	19	389	18	0	156	0		
2	156	21	409	0	0	135	1		
3	135	19	428	0	0	116	1		
4	116	25	436	17	0	108	1		
5	108	10	429	18	0	116	0		
6	116	16	427	17	0	117	1		
7	117	25	435	18	0	110	0		
8	110	21	438	17	0	106	1		
9	106	17	455	0	0	89	1		
10	89	30	485	0	0	59	1		
11	59	17	485	18	0	60	0		
12	60	17	484	17	0	60	1		
13	60	22	489	18	0	56	0		
14	56	18	489	17	0	55	1		
15	55	17	489	18	0	56	0		
16	56	22	510	0	0	34	1		
17	34	14	524	0	0	20	1		
18	20	21	528	17	0	16	1		
19	16	22	533	18	0	12	0		
20	12	21	536	17	0	8	1		
21	8	8	527	18	0	18	0		
22	18	21	530	17	0	14	1		
23	14	17	547	0	0	-3	1		
24	-3	20	567	0	0	-23	1		
25	-23	21	571	18	0	-26	0		
26	-26	17	570	17	0	-26	1		
27	-26	19	572	18	0	-27	0		
28	-27	23	577	17	0	-33	1		
29	-33	25	585	18	0	-40	0		
30	-40	22	606	0	0	-62	1		
CUMULATIVE DEMAND=					1742				
CUMULATIVE ORGANIC REPAIR=					0				
CUMULATIVE CONTRACT RPAIR=					1135				

MONTH 6		ITEMS REPAIRED					ENDING IN	
BEGINNING								
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK	
1	-189	21	732	18	4	-188	1	
2	-188	19	728	17	5	-185	2	
3	-185	16	740	0	4	-197	2	
4	-197	14	754	0	0	-211	2	
5	-211	16	747	18	6	-203	1	
6	-203	17	742	17	4	-199	2	
7	-199	23	743	18	5	-199	1	
8	-199	12	732	17	5	-189	2	
9	-189	17	726	18	6	-182	1	
10	-182	18	738	0	5	-195	2	
11	-195	16	754	0	0	-211	2	
12	-211	15	748	17	4	-205	2	
13	-205	13	740	18	4	-196	1	
14	-196	16	734	17	4	-191	2	
15	-191	18	731	18	4	-187	1	
16	-187	18	725	17	6	-182	2	
17	-182	19	740	0	4	-197	2	
18	-197	16	756	0	0	-213	2	
19	-213	7	741	18	5	-197	1	
20	-197	10	728	17	5	-185	2	
21	-185	20	726	18	5	-182	1	
22	-182	19	722	17	5	-179	2	
23	-179	19	718	18	6	-174	1	
24	-174	12	725	0	4	-182	2	
25	-182	19	744	0	0	-201	2	
26	-201	16	738	17	5	-195	2	
27	-195	18	734	18	5	-190	1	
28	-190	13	723	17	6	-180	2	
29	-180	21	723	18	4	-179	1	
30	-179	18	718	17	5	-175	2	
CUMULATIVE DEMAND=					3313			
CUMULATIVE ORGANIC REPAIR=					321			
CUMULATIVE CONTRACT RPAIR=					2272			

ANNEX XII

0 PERCENT CPL
500 HOURS MIBF

MONTH 1		BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	545	17	10	0	6	534	1
2	534	21	23	0	8	521	1
3	521	18	32	0	9	512	1
4	512	7	30	0	9	514	1
5	514	22	40	0	12	504	1
6	504	19	50	0	9	494	1
7	494	15	65	0	0	479	1
8	479	12	67	0	10	477	1
9	477	22	78	0	11	466	1
10	466	14	82	0	10	462	1
11	462	19	90	0	11	454	1
12	454	24	102	0	12	442	1
13	442	18	108	0	12	436	1
14	436	24	132	0	0	412	1
15	412	16	136	0	12	408	1
16	408	17	141	0	12	403	1
17	403	20	149	0	12	395	1
18	395	19	154	0	14	390	1
19	390	19	161	0	12	383	1
20	383	16	164	0	13	380	1
21	380	21	185	0	0	359	1
22	359	20	193	0	12	351	1
23	351	19	199	0	13	345	1
24	345	18	203	0	14	341	1
25	341	24	214	0	13	330	1
26	330	19	220	0	13	324	1
27	324	21	227	0	14	317	1
28	317	19	246	0	0	298	1
29	298	22	254	0	14	290	1
30	290	22	262	0	14	282	1

CUMULATIVE DEMAND=

564

CUMULATIVE ORGANIC REPAIR=

301

CUMULATIVE CONTRACT RPAIR=

0

MONTH	3	BEGINNING		ITEMS REPAIRED		ENDING	IN
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	113	15	426	0	20	118	1
2	118	26	437	0	15	107	1
3	107	13	450	0	0	94	1
4	94	24	457	0	17	87	1
5	87	26	465	0	18	79	1
6	79	15	463	0	17	81	1
7	81	15	461	0	17	83	1
8	83	14	459	0	16	85	1
9	85	23	466	0	16	78	1
10	78	22	488	0	0	56	1
11	56	22	493	0	17	51	1
12	51	25	500	0	18	44	1
13	44	27	510	0	17	34	1
14	34	19	511	0	18	33	1
15	33	22	515	0	18	29	1
16	29	26	526	0	15	18	1
17	18	22	548	0	0	-4	1
18	-4	24	553	0	19	-9	1
19	-9	16	550	0	19	-6	1
20	-6	25	557	0	18	-13	1
21	-13	21	560	0	18	-16	1
22	-16	22	564	0	18	-20	1
23	-20	19	566	0	17	-22	1
24	-22	18	584	0	0	-40	1
25	-40	26	592	0	18	-48	1
26	-48	21	594	0	19	-50	1
27	-50	19	596	0	17	-52	1
28	-52	15	593	0	18	-49	1
29	-49	20	594	0	19	-50	1
30	-50	21	597	0	18	-53	1
CUMULATIVE DEMAND=					1758		
CUMULATIVE ORGANIC REPAIR=					1160		
CUMULATIVE CONTRACT RPAIR=					0		

MONTH 6		ITEMS REPAIRED				ENDING IN	
DAY	BEGINNING STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	-92	14	631	0	19	-87	1
2	-87	16	628	0	19	-84	1
3	-84	15	622	0	21	-78	1
4	-78	28	650	0	0	-106	1
5	-106	16	645	0	21	-101	1
6	-101	24	648	0	21	-104	1
7	-104	16	645	0	19	-101	1
8	-101	16	640	0	21	-96	1
9	-96	21	641	0	20	-97	1
10	-97	13	632	0	22	-88	1
11	-88	16	648	0	0	-104	1
12	-104	23	650	0	21	-106	1
13	-106	16	646	0	20	-102	1
14	-102	13	640	0	19	-96	1
15	-96	12	631	0	21	-87	1
16	-87	22	631	0	22	-87	1
17	-87	20	631	0	20	-87	1
18	-87	24	655	0	0	-111	1
19	-111	15	648	0	22	-104	1
20	-104	14	640	0	22	-96	1
21	-96	15	632	0	23	-88	1
22	-88	14	626	0	20	-82	1
23	-82	20	625	0	21	-81	1
24	-81	21	625	0	21	-81	1
25	-81	21	646	0	0	-102	1
26	-102	17	644	0	19	-100	1
27	-100	19	641	0	22	-97	1
28	-97	17	637	0	21	-93	1
29	-93	13	626	0	24	-82	1
30	-82	19	622	0	23	-78	1
CUMULATIVE DEMAND=					3331		
CUMULATIVE ORGANIC REPAIR=					2708		
CUMULATIVE CONTRACT RPAIR=					0		

MONTH	8	BEGINNING		ITEMS REPAIRED		ENDING IN	
DAY	STOCK	DEMAND	REPARABLES	CONTRACT	ORGANIC	STOCK	WORK
1	-54	19	596	0	21	-52	1
2	-52	13	586	0	23	-42	1
3	-42	26	588	0	24	-44	1
4	-44	19	584	0	23	-40	1
5	-40	13	575	0	22	-31	1
6	-31	9	563	0	21	-19	1
7	-19	19	582	0	0	-38	1
8	-38	17	577	0	22	-33	1
9	-33	20	574	0	23	-30	1
10	-30	15	565	0	24	-21	1
11	-21	18	560	0	23	-16	1
12	-16	11	548	0	23	-4	1
13	-4	15	539	0	24	5	1
14	5	19	558	0	0	-14	1
15	-14	16	551	0	23	-7	1
16	-7	22	550	0	23	-6	1
17	-6	11	539	0	22	5	1
18	5	12	528	0	23	16	1
19	16	12	517	0	23	27	1
20	27	24	516	0	25	28	1
21	28	24	540	0	0	4	1
22	4	15	532	0	23	12	1
23	12	17	525	0	24	19	1
24	19	20	523	0	22	21	1
25	21	20	520	0	23	24	1
26	24	19	517	0	22	27	1
27	27	12	505	0	24	39	1
28	39	17	522	0	0	22	1
29	22	14	514	0	22	30	1
30	30	10	499	0	25	45	1
CUMULATIVE DEMAND=				4359			
CUMULATIVE ORGANIC REPAIR=				3859			
CUMULATIVE CONTRACT RPAIR=				0			

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